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Global Atmospheric Circulation Statistics, 1000-1 mb

National Center for Atmospheric Research, Boulder, CO

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Abstract: This atlas presents atmospheric general circulation statistics derived from twelve years (1979-1990) of daily National Meteorological Center (NMC) operational geopotential height analyses; it is an update of a prior atlas using data over 1979-1986. These global analyses are available on pressure levels covering 1000-1 mb (approximately 0-50 km). The geopotential grids are a combined product of the Climate Analysis Center (which produces analyses over 70-1 mb) and operational NMC analyses (over 1000-100 mb). Balanced horizontal winds and hydrostatic temperatures are derived from the geopotential fields.

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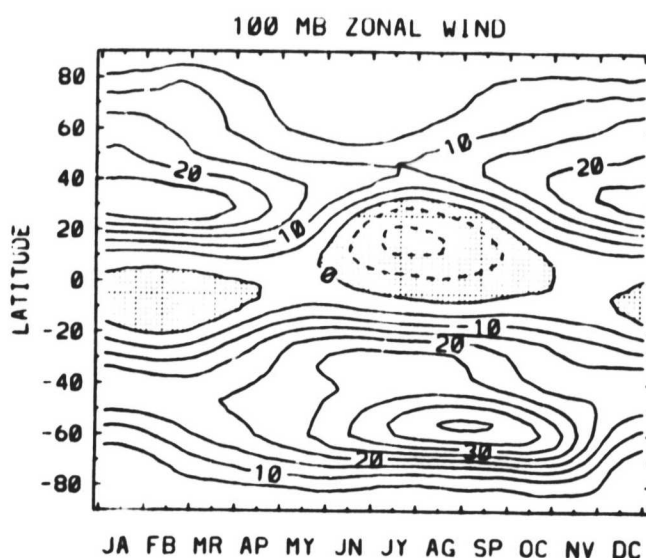
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ATMOSPHERIC CHEMISTRY DIVISION

NATIONAL CENTER FOR ATMOSPHERIC RESEARCH
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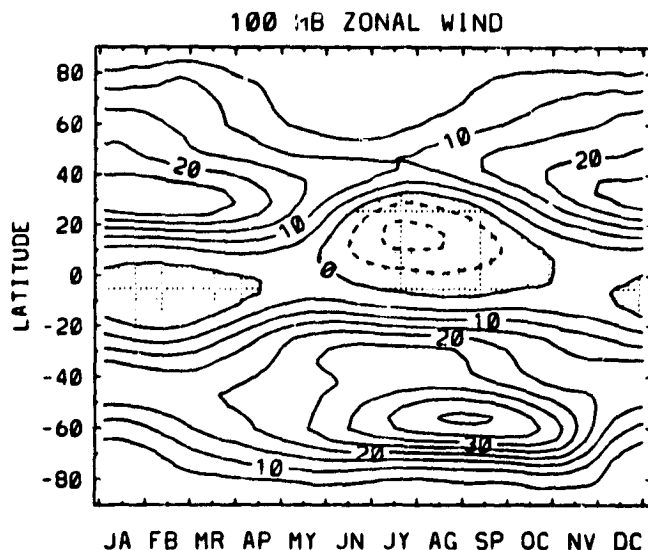
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PREFACE

This atlas presents atmospheric general circulation statistics derived from twelve years (1979-1990) of daily National Meteorological Center (NMC) operational geopotential height analyses; it is an update of a prior atlas using data over 1979-1986. These global analyses are available on pressure levels covering 1000-1 mb (approximately 0-50 km). The geopotential grids are a combined product of the Climate Analysis Center (which produces analyses over 70-1 mb) and operational NMC analyses (over 1000-100 mb). Balanced horizontal winds and hydrostatic temperatures are derived from the geopotential fields. This atlas presents monthly means, along with daily and interannual variabilities, of various circulation statistics derived from these data: zonal mean temperatures and winds, poleward heat and momentum fluxes, Eliassen-Palm flux divergences, and stationary and transient planetary wave statistics. Meridional cross sections are presented for each month, along with Northern Hemisphere and Southern Hemisphere polar projections at various pressure levels for January, April, July, and October. Climatological latitude-time and height-time cross sections of zonal mean winds, temperatures and wave fluxes are presented to define seasonal variability, and actual time series for each year are included to show true daily variability. Finally, tables of monthly average zonal mean winds and temperatures are given for reference. This atlas is presented for a concise climatology of dynamical quantities throughout the troposphere and stratosphere, as a climatology of planetary wave statistics, and to alert potential users to the availability of these data.

Acknowledgments: This updated version of this atlas was completed in the Atmospheric Chemistry Division at NCAR, with support from NASA Grant W-16215. The majority of the work was actually completed in connection with the prior version, under support from the Advanced Study Program at NCAR. Constructive reviews were supplied by Rolando Garcia and Kevin Trenberth. Marilena Stone and Ursula Rosner helped with preparation of the manuscript. NCAR is sponsored by the National Science Foundation.

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1. DATA DESCRIPTION

ORIGIN

The data used here are horizontal wind and temperature fields derived from daily geopotential height grids covering 1000-1 mb for the years 1979-1990. Grids at pressure levels 1000, 850, 700, 500, 400, 300, 250, 200, 150, and 100 mb are 1200 GMT output of the Global Data Assimilation System (GDAS) used at the National Meteorological Center (NMC). This system is described by McPherson *et al.* (1979). These analyses result from optimal interpolation of all available observations with first-guess fields provided by the NMC prediction model.

Stratospheric grids at 70, 50, 30, 10, 5, 2, 1 and 0.4 mb are 1200 GMT daily operational analyses produced by the Climate Analysis Center (CAC) section of NMC. These data are produced using available radiosonde observations (RAOBS) in a modified successive correction (Cressman) analysis, with satellite-derived temperature retrievals used as first-guess fields (see Gelman *et al.*, 1986, and references therein). The satellite-derived temperature retrievals are obtained principally from the TIROS Operational Vertical Sounder (TOVS) series, which have been operational since late 1978. TOVS is comprised of three radiometers which observe the stratosphere and troposphere (Smith *et al.*, 1986): the High Resolution Infrared Radiation Sounder (HIRS-2), the Microwave Sounding Unit (MSU) and the Stratospheric Sounding Unit (SSU). Because the uppermost analysis level at 0.4 mb lies substantially above the peak of the uppermost satellite radiometer weighting function (SSU channel 3, which peaks near 1.5 mb), data at this level are of suspect quality and not used in this atlas. As a note, CAC produces separate analyses of temperature and geopotential height at stratospheric levels. The temperatures used in this atlas are not based on their direct temperature analyses, but calculated hydrostatically from the height fields.

Other recent compilations of stratospheric climatological data include Hamilton (1982), Geller *et al.* (1983) and Wu *et al.* (1987), who use subsets of the NMC/CAC data used here, and geostrophically-derived winds. Labitzke *et al.* (1985) provide a climatology of monthly mean zonal mean temperatures, zonal winds and stationary planetary wave amplitudes and phases up to 80 km (0.01 mb). Their analyses are based on two years of Nimbus 5 Selective Chopper Radiometer (SCR) combined with three years of Nimbus 6 Pressure Modulated Radiometer (PMR) inverted radiances. Marks (1989) presents balanced winds and stationary wave fluxes derived from these data. Fleming *et al.* (1988) extended this climatology up to 120 km (0.0001 mb), providing useful cross sections and other derived quantities. Comparisons between these data and NMC/CAC derived statistics show reasonable agreement; some differences are found between calculations based on geostrophic versus balanced winds. This atlas furthermore includes transient wave statistics, and documents the daily and interannual variabilities of dynamical quantities over 1000-1 mb. Apart from the changes in satellite retrievals and analysis schemes described in the next section, it is clear that twelve years of data is insufficient to quantify the interannual variability of the stratosphere (Labitzke and Naujokat, 1983, for example, examine data from 1955-1982); the objective here is to give qualitative and structural information.

CHANGES IN OPERATIONAL ANALYSIS SYSTEMS

Because statistics of interannual variability are presented here, it is important to be aware of changes in the analysis schemes. Both the NMC 1000-100 mb analyses and the CAC 70-1 mb data are operational products, and as such are continually undergoing changes in both processing and sources of data in order to produce the best product. Changes in the NMC GDAS assimilation system and resulting discontinuities in products over 1979-1986 have been summarized in Trenberth and Olson (1987). Important modifications in the NMC forecast model used to generate the first guess fields include a change from gridpoint to spectral model and the use of nonlinear normal mode

initialization (May 1980), various changes in horizontal and vertical resolution, and a host of changes in data use criteria. Trenberth and Olson's analyses suggest that these changes have the largest impact in the tropics and for fields such as relative humidity; the impact on extratropical geopotential height analyses are probably smaller. One region where there were obvious problems in the NMC analyses was in the troposphere over Antarctica prior to May 1986 (Bonner *et al.*, 1986); correction of this problem leads to large interannual temperature variability that is purely an artifact of the change in analyses.

Changes in the stratospheric 70-1 mb analyses include modifications of the satellite-derived first guess fields, and differing criteria for the inclusion of RAOB data over 70-10 mb; these are summarized in Gelman *et al.* (1986). Direct inclusion of RAOB data in the SH analyses was discontinued after 17 October 1980. Satellite temperature retrievals prior to 17 October 1980 were produced via linear regression of Vertical Temperature Profile Radiometer (VTPR) and SSU channels 1 and 2 measurements. From 17 October 1980 to the present, temperature retrievals from TOVS have been used. A series of TOVS instruments have been put into orbit aboard a succession of operational satellites; these instruments do not yield identical radiance measurements for a variety of reasons, and derived temperatures may change substantially when a new instrument is introduced (Johnson *et al.*, 1986; Nash and Forrester, 1986; see also Chapter 6 of WMO, 1988). Gelman *et al.* (1986) have compared the operationally derived temperatures with co-located radiosonde and rocketsonde temperatures, and find systematic biases for each different satellite system of order $\pm 3-6$ K in the 5-0.4 mb analyses. They suggest that corrections be applied to the satellite-derived analyses at and above 5 mb to remove these biases. *Such corrections have not been applied to the data used here*, and a component of the calculated interannual variability in temperatures at these levels is due to changes in data acquisition. This can be clearly seen, for example, as localized maxima near 5 mb in zonal mean temperature interannual variability maps. Note, however, that such biases

are not strong functions of horizontal position, and derived horizontal winds are probably not as strongly biased by the introduction of different satellite instruments. Therefore, interannual variability of the upper stratosphere in these data is probably best viewed in terms of zonal wind variability.

The stratospheric CAC analyses are produced separately for each hemisphere on a 65×65 polar stereographic grid. Although all the original CAC 65×65 stratospheric grids contain full fields, data equatorward of 20° in the Northern Hemisphere was purely extrapolated from higher latitudes until 29 February 1984. Following this time, the first guess fields have been archived over $0-20^\circ$ N. To provide complete analyses here, the geopotential fields prior to 1 March 1984 have been linearly interpolated over $0-20^\circ$ at and above 70 mb.

GEOPOTENTIAL GRID PROCESSING

The geopotential height data over 1000-1 mb have been archived via zonal Fourier components, up to zonal wave number 12, on a 40-point Gaussian grid in latitude (with approximate spacing of 4.5 degrees). This latitude resolution is that associated with rhomboidal spherical harmonic truncation at wave number 15 (R15). The stratospheric data are obtained from NMC on 65×65 -point polar stereographic grids; these were interpolated via a Bessel 16-point two dimensional scheme to a latitude-longitude grid, followed by zonal Fourier analysis. Some of the 1000-100 mb NMC data were obtained from the $2.5^\circ \times 2.5^\circ$ latitude-longitude NMC grids archived at NCAR.

Missing data (less than 5% of the grids) have been linearly interpolated in time, and some obviously bad data have been replaced by interpolated values. The global data are stored by month and year on the Mass Storage System at NCAR. Prospective users of the data are welcome, and may simply contact the author.

TEMPERATURE, WIND AND WAVE FLUX DERIVATIONS

Temperatures are derived from the geopotential grids via the hydrostatic relation:

$$T = -R \frac{\partial \Phi}{\partial \ln p} \quad (1)$$

Here Φ is the geopotential height, $\ln p$ is the logarithm of pressure, and R the gas constant ($287 \text{ m}^2 \text{ s}^{-2} \text{ K}^{-1}$). Although simply called temperature here, this expression actually results in the virtual temperature (the temperature of dry air having the same density and pressure as the true, moist air).

Zonal mean winds are evaluated from the so-called gradient wind expression:

$$\frac{\bar{u}^2}{a} \tan \phi + 2\Omega \sin \phi \cdot \bar{u} + \frac{1}{a} \frac{\partial \bar{\Phi}}{\partial \phi} = 0 \quad (2)$$

Values at the equator are evaluated from the curvature expression:

$$\bar{u} + \frac{1}{2\Omega a} \cdot \frac{\partial^2 \bar{\Phi}}{\partial \phi^2} = 0 \quad (3)$$

Fleming and Chandra (1989) have compared equatorial winds derived from these data via Eq. 3 with monthly mean rawinsonde and rocketsonde measurements. They show that the derived winds reproduce the general characteristics of the quasi-biennial oscillation (QBO) and semi-annual oscillation (SAO), although the amplitude of the QBO is substantially underestimated in the derived winds.

Zonal Fourier components of horizontal winds are derived from the zonal and meridional momentum equations linearized about the zonal mean zonal wind \bar{u} :

$$\frac{\bar{u}}{a \cos \phi} \frac{\partial u'}{\partial \lambda} + \hat{f} v' + \frac{1}{a \cos \phi} \frac{\partial \Phi'}{\partial \lambda} = 0 \quad (4a)$$

$$\frac{\bar{u}}{a \cos \phi} \frac{\partial v'}{\partial \lambda} + \tilde{f} u' + \frac{1}{a} \frac{\partial \Phi'}{\partial \phi} = 0 \quad (4b)$$

In Eqns. (2)-(4), λ is longitude, ϕ latitude, u and v the zonal and meridional velocities, respectively, and a is earth radius (6.37×10^6 m). Overbars denote zonal means and primes deviations therefrom, and

$$\hat{f} = \left[2\Omega \sin \phi - \frac{1}{a \cos \phi} \frac{\partial}{\partial \phi} (\bar{u} \cos \phi) \right] \quad (4c)$$

$$\tilde{f} = \left[2\Omega \sin \phi + \frac{2\bar{u}}{a} \tan \phi \right] \quad (4d)$$

where Ω is earth rotation rate ($7.3 \times 10^{-5} \text{ sec}^{-1}$). The coupled equations (4a-b) are solved for each zonal wave number to evaluate the spectral coefficients of u' and v' ; note that these equations become singular for zonal wave k as

$$\delta \equiv \frac{(\bar{u} \cdot k / a \cos \phi)^2}{\hat{f} \tilde{f}} \rightarrow 1 \quad (4e)$$

For the data presented here, geostrophic winds were substituted if $\delta > 0.5$ (the results are not sensitive to this exact value). The use of these balanced winds and their improved treatment of stratospheric data (as compared to geostrophic winds) is discussed extensively in Randel (1987).

Statistics of several derived quantities are also presented here. A measure of the zonal mean static stability is given by the Brunt-Vaisala (or bouyancy) frequency squared:

$$N^2 = \frac{R}{H} \left(\frac{\partial \bar{T}}{\partial z} + \frac{\kappa \bar{T}}{H} \right) \quad (5)$$

where H is the atmospheric scale height, chosen here to be 7000 m, $z = H \ln(1000 \text{ mb}/p)$ is the vertical coordinate, and $\kappa = 2/7$. Relatively large values of N^2 correspond to strong stability with respect to vertical motions. A central quantity in the quasi-geostrophic theory of Rossby wave propagation and stability of the zonal mean flow is the latitudinal gradient of zonal mean potential vorticity:

$$\begin{aligned} \bar{q}_y = & \frac{2\Omega}{a} \cos \phi - \frac{1}{a^2} \frac{\partial}{\partial \phi} \left[\frac{1}{\cos \phi} \frac{\partial}{\partial \phi} (\bar{u} \cos \phi) \right] \\ & - (2\Omega \sin \phi)^2 \cdot e^{z/H} \frac{\partial}{\partial z} \left(e^{-z/H} \cdot \frac{1}{N^2} \cdot \frac{\partial \bar{u}}{\partial z} \right) \end{aligned} \quad (6)$$

A zonal cross section of potential temperature (Θ) and Rossby-Ertel potential vorticity (PV) is included for each month. Potential temperature is calculated as:

$$\Theta = T \left(\frac{1000 \text{ mb}}{p} \right)^\kappa \quad (7)$$

and potential vorticity from:

$$PV = -g(2\Omega \sin \phi + \zeta) \cdot \frac{\partial \Theta}{\partial p} \quad (8a)$$

Here ζ is the relative vorticity, and $g = 9.81 \text{ m} \cdot \text{sec}^{-2}$. For the zonal mean, this reduces to

$$\overline{PV} = -g \left[2\Omega \sin \phi - \frac{1}{a \cos \phi} \frac{\partial}{\partial \phi} (\bar{u} \cos \phi) \right] \cdot \frac{\partial \bar{\Theta}}{\partial p} \quad (8b)$$

PV is scaled in units of $10^{-6} \text{ K m}^2 \text{ kg}^{-1} \text{ s}^{-1}$, termed a PV unit. Statistics of the zonally-averaged poleward eddy heat flux ($\overline{v'T'}$) and poleward eddy momentum flux ($\overline{u'v'}$) are calculated and displayed. Also calculated are estimates of the zonal mean Eliassen-Palm (EP) flux vectors and their divergence. The orientation of the EP flux vectors indicates the wave group velocity or direction of wave activity flux (where such quantities are well defined), and the relative importance of heat versus momentum fluxes. The EP flux

divergence (also called the wave driving) gives a concise measure of the net effect of wave-induced heat and momentum fluxes in terms of a force per unit mass on the zonal mean flow; it is also equivalent to the poleward flux of quasi-geostrophic potential vorticity. A review of the motivation and theory behind EP flux diagnostics can be found in Edmon *et al.* (1980). Here the EP flux vectors and divergences are estimated using the primitive equation expressions, neglecting terms involving the vertical velocity. The zonal mean wave driving (DF) is given by:

$$DF = \frac{1}{\rho(z) \cdot a \cos \phi} (\nabla \cdot \vec{F}) \quad (9)$$

$$= \frac{1}{\rho(z) \cdot a \cos \phi} \left[\frac{1}{a \cos \phi} \frac{\partial}{\partial \phi} (F_\phi \cos \phi) + \frac{\partial F_z}{\partial z} \right]$$

with

$$F_\phi = \rho(z) \cdot a \cos \phi \left[-\overline{u'v'} - \frac{R}{H} \cdot \frac{\partial \bar{u}}{\partial z} \cdot \frac{\overline{v'T'}}{N^2} \right] \quad (10a)$$

$$F_z = \rho(z) \cdot a \cos \phi \cdot \left[\hat{f} \cdot \frac{R}{H} \cdot \frac{\overline{v'T'}}{N^2} \right] \quad (10b)$$

Here $\rho(z)$ is the basic state density (proportional to $e^{-z/H}$). EP flux diagrams here follow the convention in Randel *et al.* (1987); notably, the vectors are multiplied by $e^{z/2H}$ so that they are visible throughout the stratosphere. Because the use of balanced winds in the tropics is problematic, wave fluxes and EP diagnostics are displayed only polewards of 20° in each hemisphere.

Vertical derivatives are approximated by finite differences between adjacent pressure levels, followed by linear interpolation in log pressure back to the original pressure levels. Because of the separate analysis schemes at 100 and 70 mb, and the high number of derivatives used, eddy heat fluxes occasionally show discontinuous behavior between the 100 and 70 mb levels. Further vertical differentiation of these fluxes can

result in obviously bad EP flux divergence estimates; this problem is alleviated here by smoothing the eddy heat flux values across 100 and 70 mb prior to the EP flux calculations. Meridional derivatives are approximated by centered finite differences on the Gaussian latitude grid, and longitudinal derivatives are calculated spectrally.

2. STATISTICAL CALCULATIONS

Zonal mean temperature and wind and zonal mean wave flux statistics presented here are calculated as follows (ψ_i^j represents the value of variable ψ for year i ($i=1-12$ for 1979-1990) and day j ($j=1-31$ for January, etc.)):

(1) Monthly means:

$$[\psi]_i = \frac{1}{31} \sum_{j=1}^{31} \psi_i^j \quad (11)$$

(2) Ensemble monthly means:

$$\langle \psi \rangle = \frac{1}{12} \sum_{i=1}^{12} [\psi]_i \quad (12)$$

(3) Ensemble average daily standard deviation (about the respective monthly means)

$$\sigma_{daily} = \left[\frac{1}{12} \sum_{i=1}^{12} \frac{1}{31} \sum_{j=1}^{31} \left(\psi_i^j - [\psi]_i \right)^2 \right]^{1/2} \quad (13)$$

(4) Interannual standard deviation of monthly means (about the ensemble average):

$$\sigma_{int} = \left[\frac{1}{12} \sum_{i=1}^{12} ([\psi]_i - \langle \psi \rangle)^2 \right]^{1/2} \quad (14)$$

The daily and interannual variability estimates are not unbiased estimates of the variance (since the normalization factor is the number of samples), but have the advantage that the

variances σ_{daily} and σ_{int} may be summed to give the total variance about the ensemble mean.

Zonal averages of daily transient wave geopotential height and temperature fluctuations are calculated from:

$$\sigma_{\text{trans}} = \frac{1}{2\pi} \int_0^{2\pi} \left[\frac{1}{12} \sum_{i=1}^{12} \frac{1}{31} \sum_{j=1}^{31} (\phi_i^j - [\phi]_i)^2 \right]^{1/2} d\lambda \quad (15)$$

where ϕ_i^j is the daily geopotential height or temperature and $[\phi]_i$ is the monthly mean at each latitude, longitude and pressure. Horizontal cross sections of the daily geopotential height variances are also included for several pressure levels. The zonally averaged variability defined in Eq. 15 can be compared with the standard deviation about the zonal mean due to all stationary waves, calculated from:

$$\sigma_{\text{stat}} = \left[\frac{1}{2} \sum_{k=1}^{12} (\langle S_k \rangle^2 + \langle C_k \rangle^2) \right]^{1/2} \quad (16)$$

Also calculated is the ensemble average amplitude of stationary zonal waves 1-3 individually, calculated from the twelve year ensemble average sine $\langle S_k \rangle$ and cosine $\langle C_k \rangle$ coefficients via:

$$\langle \text{AMP}_k \rangle = \left[\langle S_k \rangle^2 + \langle C_k \rangle^2 \right]^{1/2}. \quad (17)$$

Note that the squared amplitudes ($\langle \text{AMP}_k \rangle^2$ in Eq. 17) sum to twice the variance (σ_{stat}^2 in Eq. 16). Stationary wave heat and momentum fluxes and EP flux divergences are similarly calculated from the ensemble sine and cosine coefficients, and transient waves are defined as the total minus stationary contribution. Note that as defined here, stationary means the wave components which are constant over the entire twelve years of

data (and are thus in some sense truly stationary). Interannual variations in monthly mean wave quantities is then by definition part of the transient wave component.

Latitude-time and height-time sections of zonal mean winds, temperatures and planetary wave amplitudes are calculated from three-day non-overlapping means to save computing space. This results in 122 values (triads) per year (except for leap years, the last triad is the average of days 364 and 365). These three-day mean values for the l th triad ($l=1-122$) are denoted ψ_i^ℓ . 'Low-frequency' values are defined as 11-point running means:

$$\tilde{\psi}_i^\ell = \frac{1}{11} \sum_{n=-5}^5 \psi_i^{\ell+n} \quad (18)$$

i.e., 33-day running mean (this is done to approximate monthly means). Ensemble means are twelve year averages of the low-frequency values:

$$\{\psi^\ell\} = \frac{1}{12} \sum_{i=1}^{12} \tilde{\psi}_i^\ell \quad (19)$$

Ensemble 'daily' variances are calculated as squared differences between the three-day mean and 33-day mean values:

$$\sigma_{daily}^\ell = \left[\frac{1}{12} \sum_{i=1}^{12} (\psi_i^\ell - \tilde{\psi}_i^\ell)^2 \right]^{1/2} \quad (20)$$

Interannual variances of the 33-day means is calculated from:

$$\sigma_{int}^\ell = \left[\frac{1}{12} \sum_{i=1}^{12} (\tilde{\psi}_i^\ell - \{\psi^\ell\})^2 \right]^{1/2} \quad (21)$$

Ensemble rms zonal wave 1-3 (and 4-8) geopotential height and temperature amplitudes are calculated from:

$$Z_{rms}^{\ell} = \left[\frac{1}{12} \sum_{i=1}^{12} \sum_{k=1}^3 \left(ZS_{i,k}^{\ell^2} + ZC_{i,k}^{\ell^2} \right) \right]^{1/2} \quad (22)$$

Ensemble stationary zonal wave 1, 2 and 3 geopotential height and temperature amplitudes are calculated from 'low-frequency' ensemble means (eq. 18) as:

$$Z_{stat_k}^{\ell} = \left[\{ZS_k^{\ell}\}^2 + \{ZC_k^{\ell}\}^2 \right]^{1/2} \quad (23)$$

Ensemble rms transient wave amplitudes are given by:

$$Z_{trans_k}^{\ell} = \left[\frac{1}{12} \sum_{i=1}^{12} \left(ZS_{i,k}^{\ell} - \{ZS_k^{\ell}\} \right)^2 + \left(ZC_{i,k}^{\ell} - \{ZC_k^{\ell}\} \right)^2 \right]^{1/2} \quad (24)$$

with definitions as above.

The use of three-day non-overlapping means will remove much of the variance with periods less than five days; this should have little effect in the stratosphere, where much of the variance is on time scales of 5 days and longer. Figure 1 illustrates December zonal mean wind daily variability calculated from daily (top) and 3-day mean data (bottom). Near identical patterns demonstrate the small bias introduced by using three day means. The use of three-day means is probably a poorer approximation for the RMS zonal wave 4-8 variance, because shorter scale waves tend to have faster time scales.

It will be noted that there can be a significant reduction in the daily variability calculated from 33-day running means versus that calculated as deviations from the discrete monthly means (as presented in the meridional cross sections). This is due to excessive variance associated with using monthly means as the basis for deviation during

times of strong seasonal variability; an example is shown in Fig. 2. Where differences exist, the running mean values of triad deviations are more representative of true daily variability about the seasonal cycle. 'Daily variability' estimates in the seasonal diagrams have a spectral response function which maximizes for periods of 5-55 days.

Latitude-time sections of wave fluxes also use 122-triad values per year, but the fluxes are calculated for each of the individual three days prior to averaging. 'Stationary wave' fluxes are calculated from 33-day running mean sine and cosine spectral coefficients, and 'transient wave' fluxes are simply the total minus stationary wave contribution.

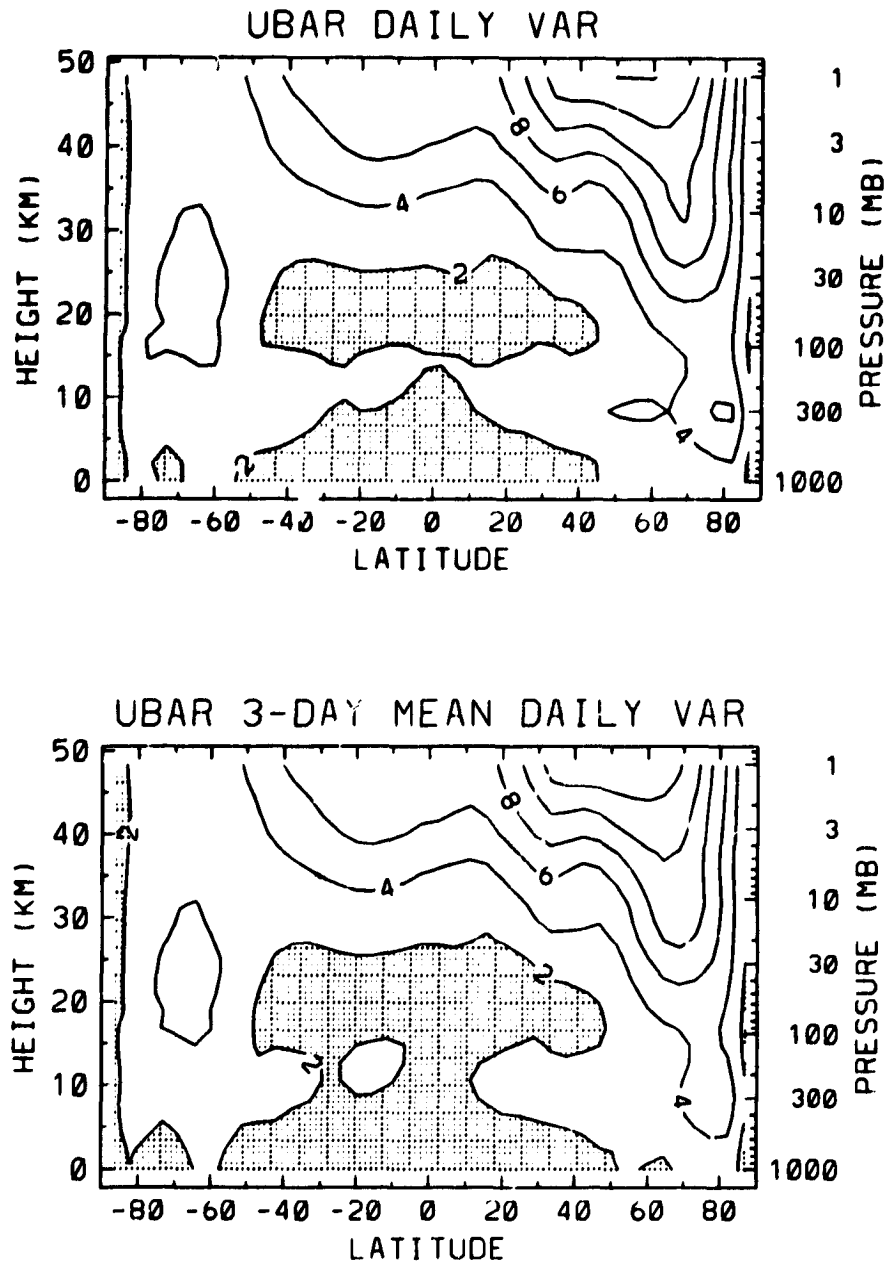


Fig. 1. Meridional cross section of the daily standard deviation of zonal mean wind in December (m/s), calculated using daily data (top), and 3-day non-overlapping means (bottom). The good agreement shows that 3-day means are appropriate for estimating daily variability.

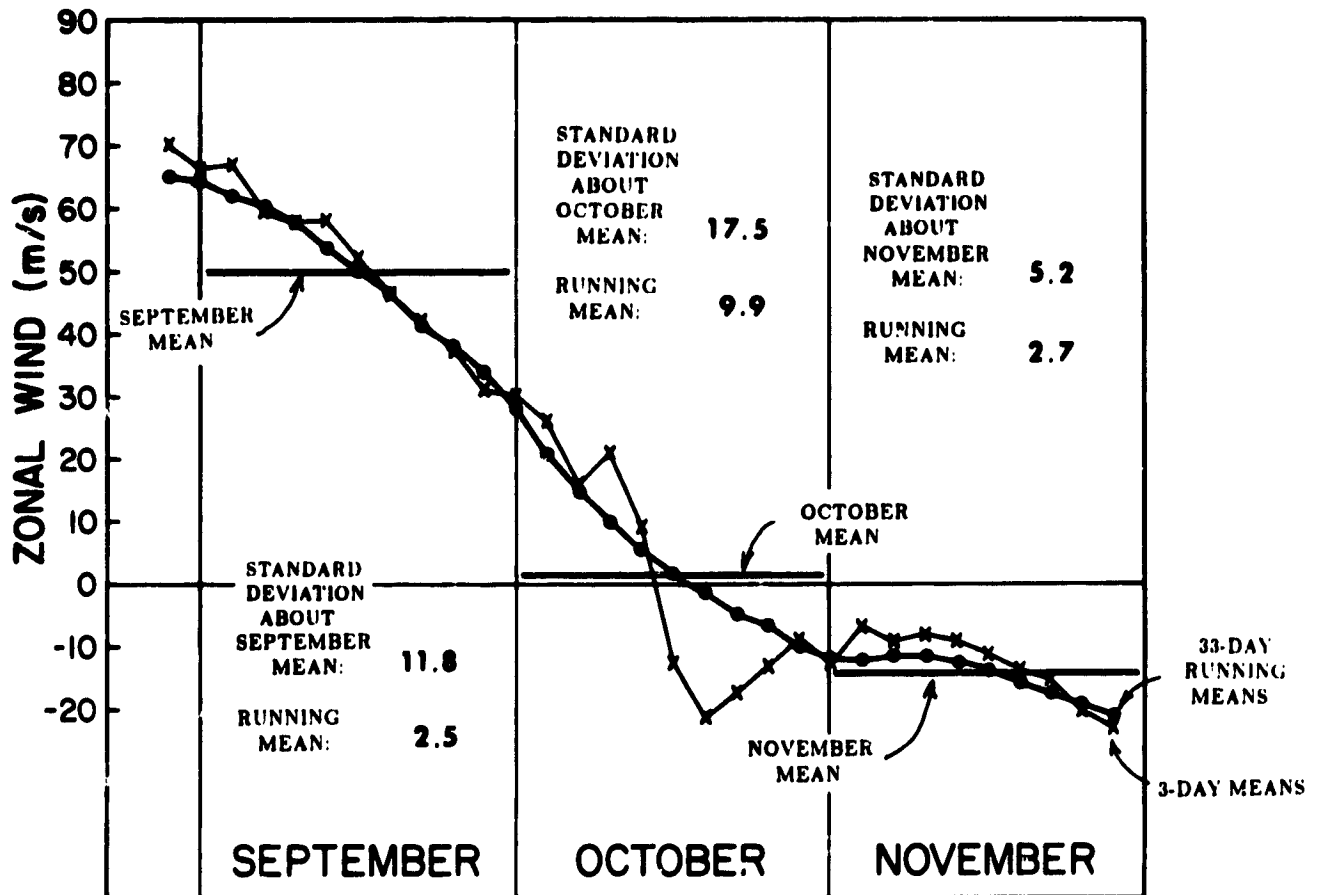


Fig. 2. Time series of 3-day mean zonal wind at 1 mb, 60 S during September-November 1979, along with the 'low-frequency' (33-day running means) and monthly mean values. The numbers indicate the triad standard deviations for each month, calculated about the monthly means, and about the running means. Note that the standard deviation about the monthly means are substantially larger, due to the strong seasonal transition at this time.

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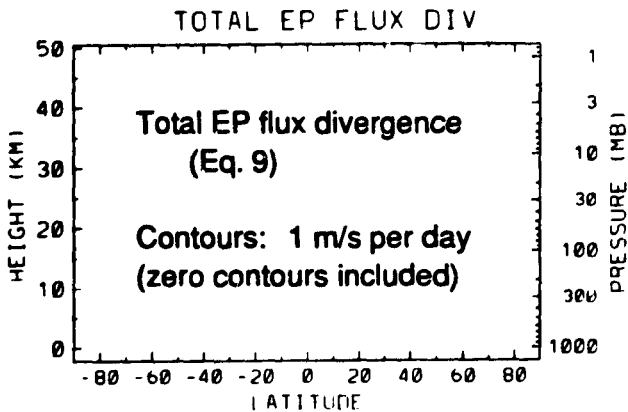
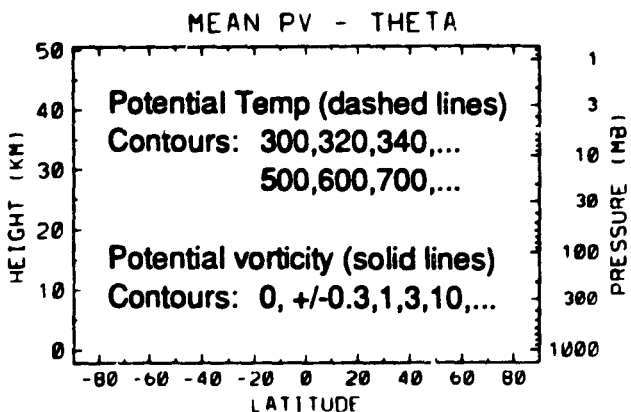
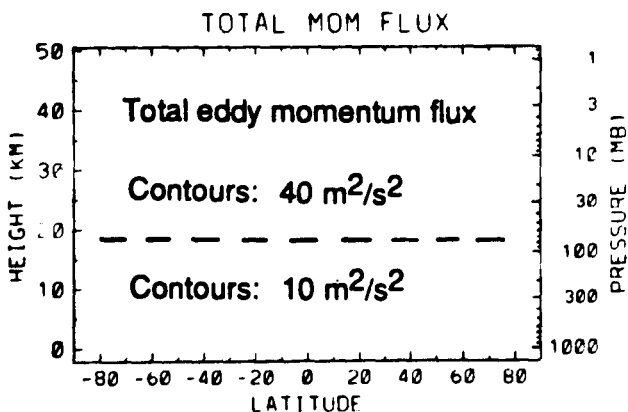
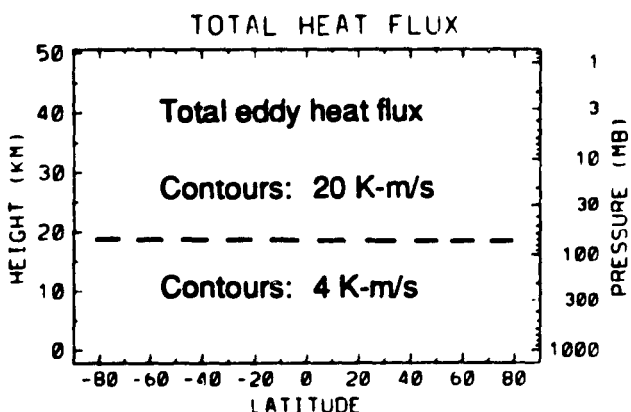
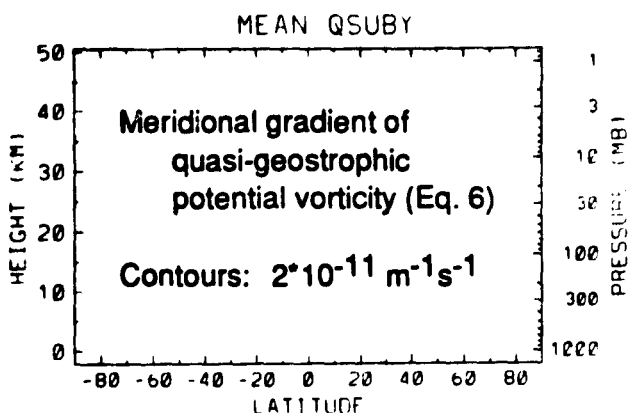
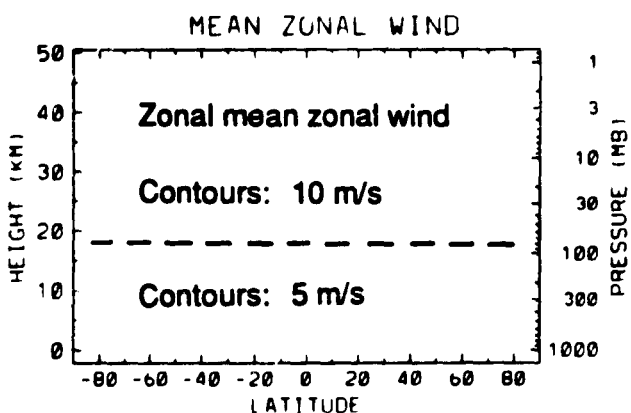
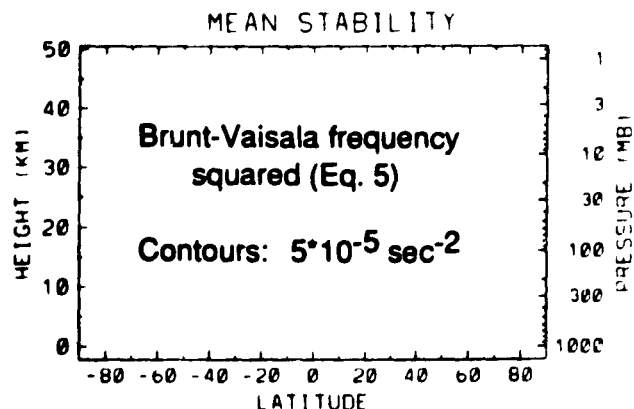
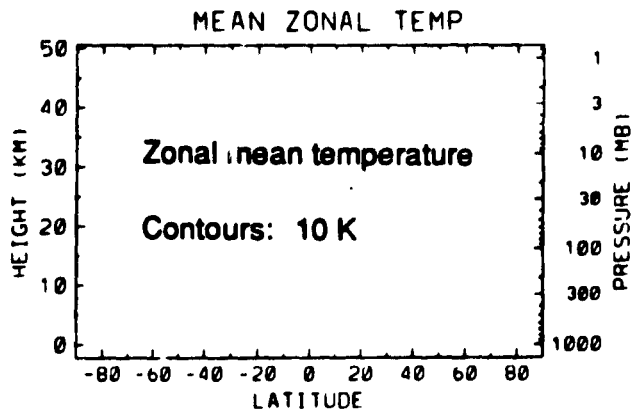
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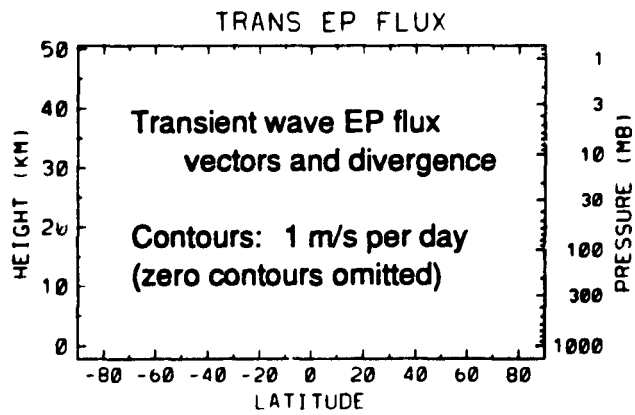
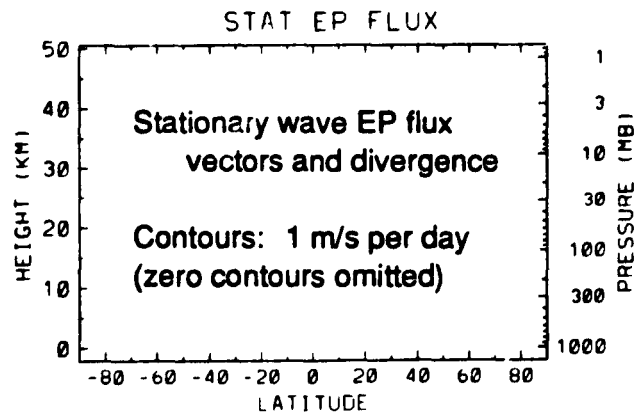
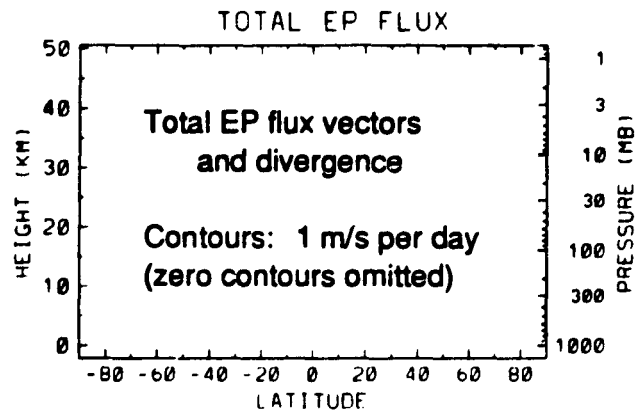
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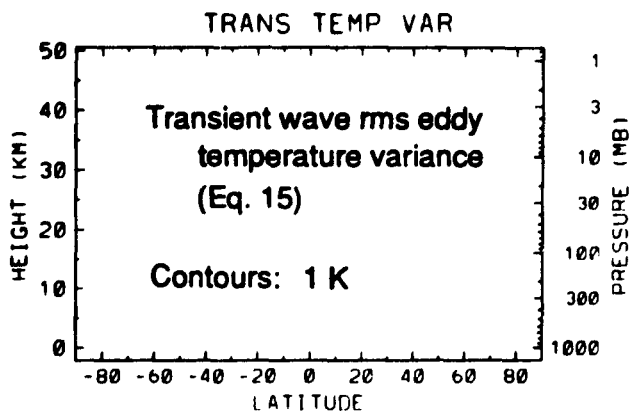
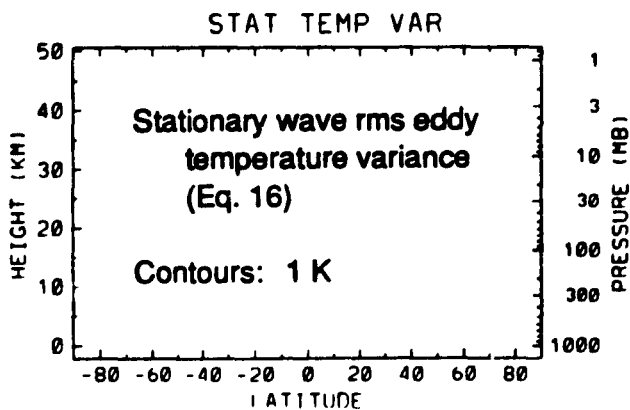
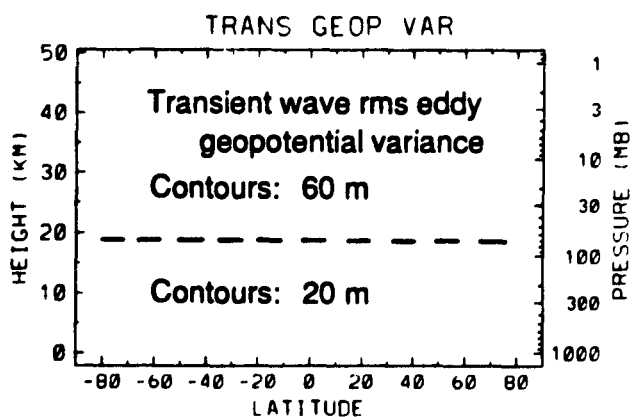
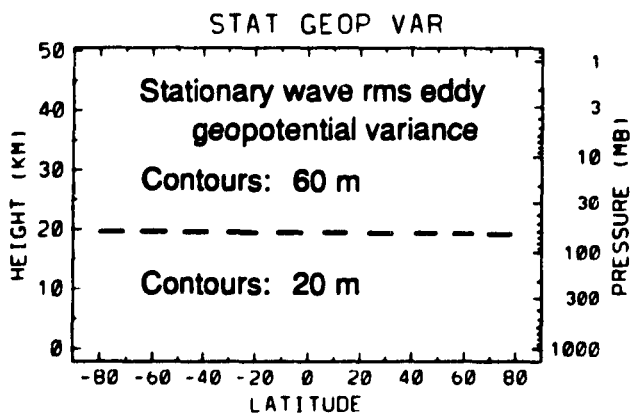
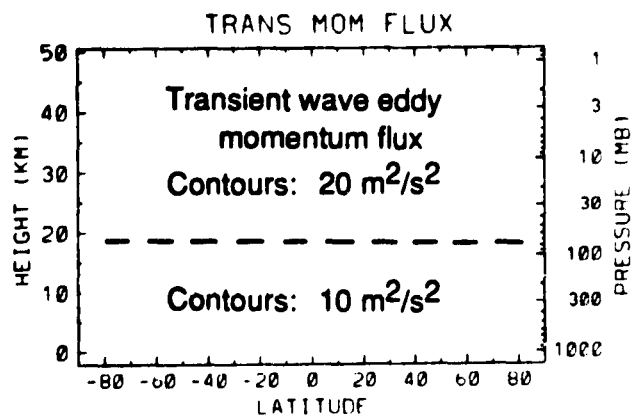
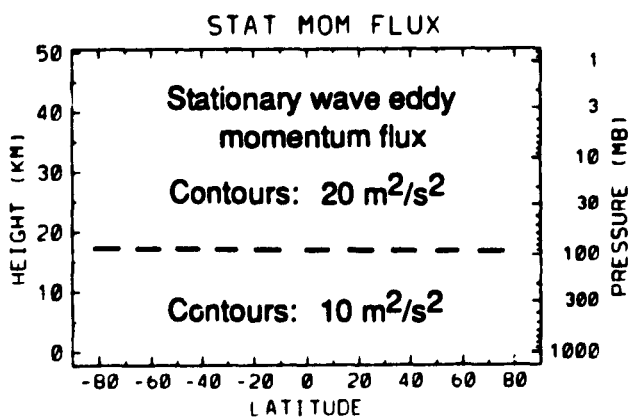
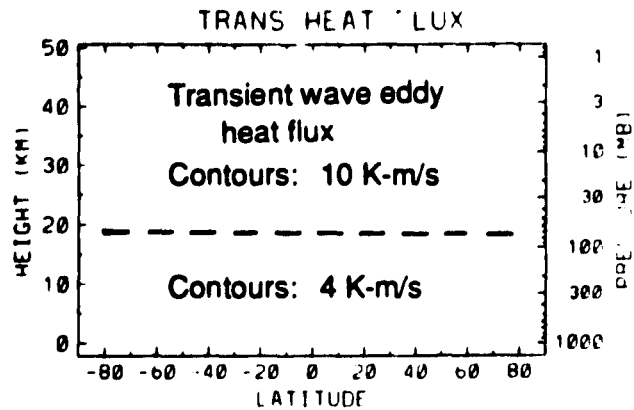
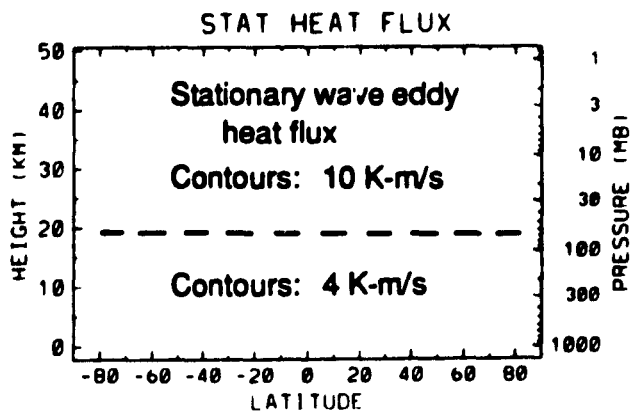
4. RESULTS

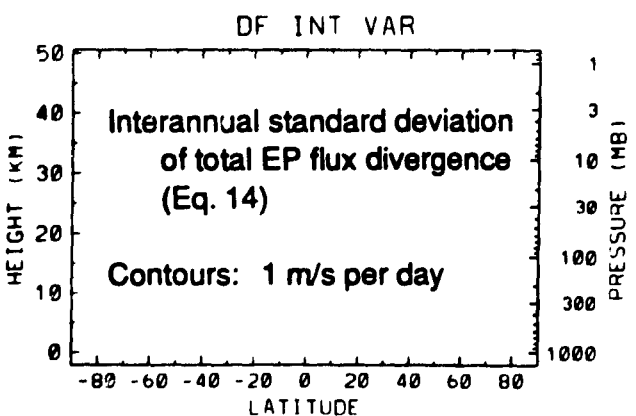
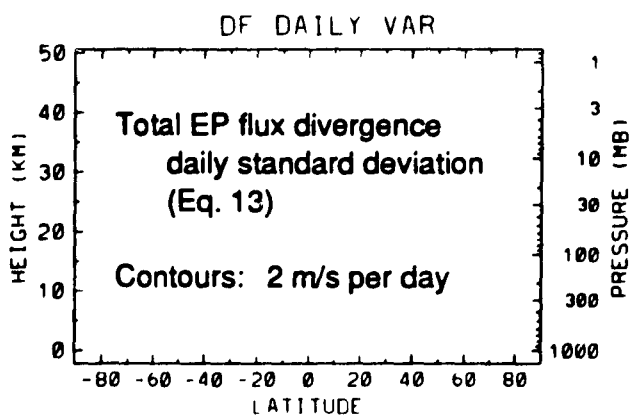
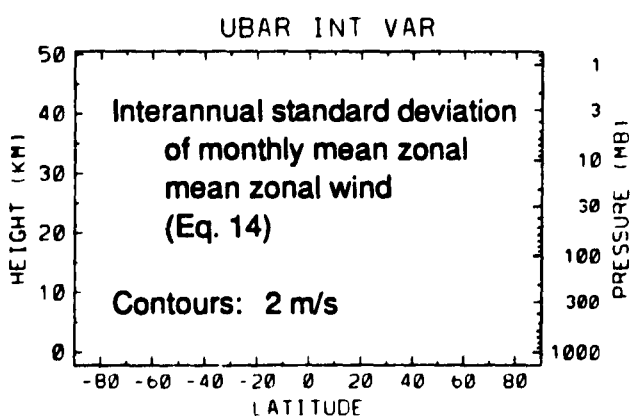
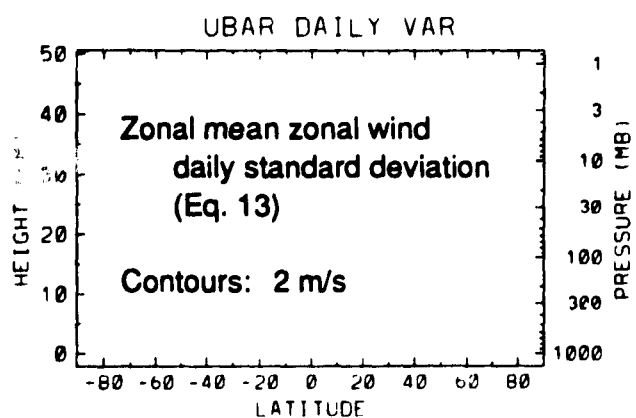
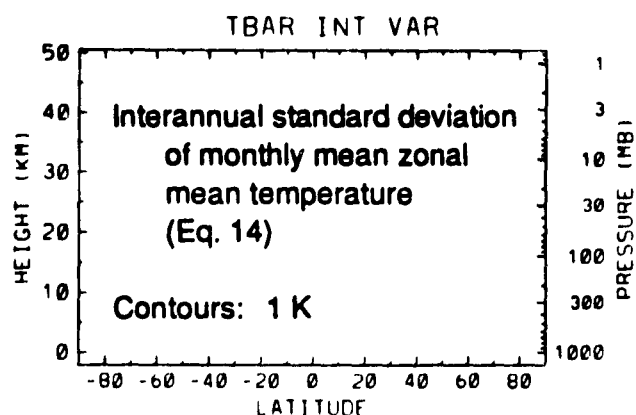
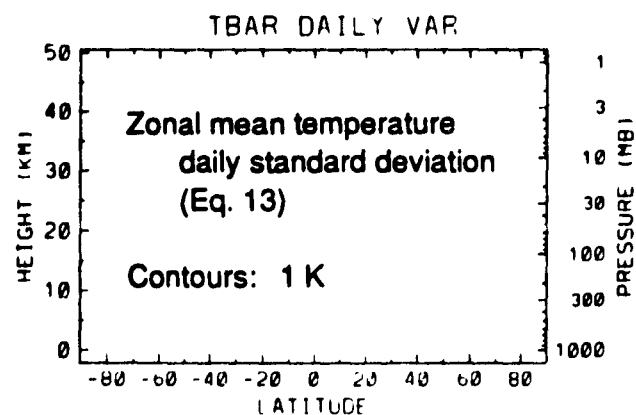
MONTHLY AVERAGE MERIDIONAL CROSS SECTIONS

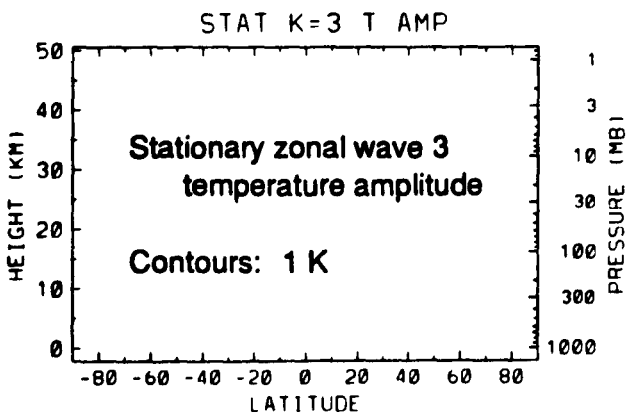
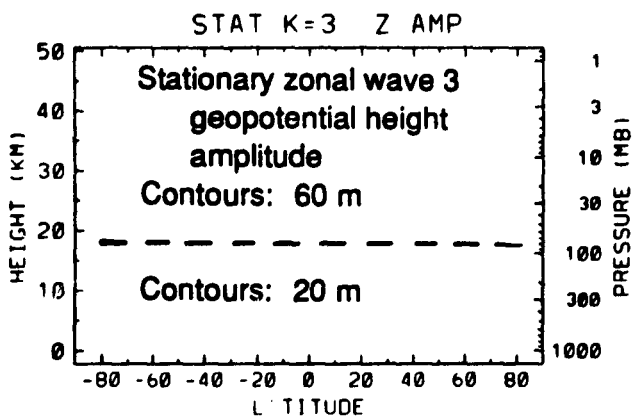
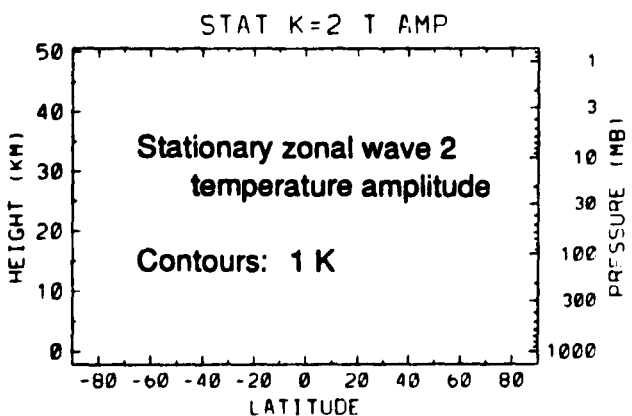
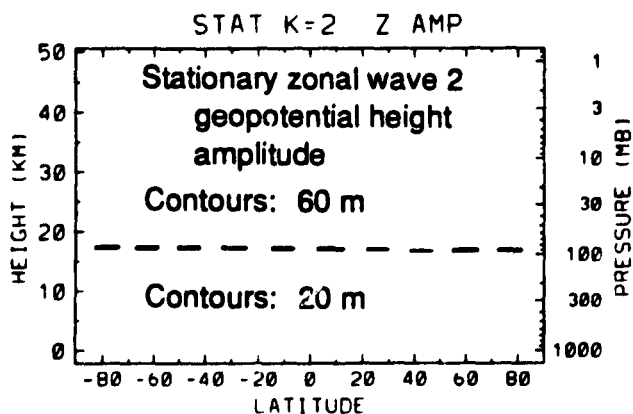
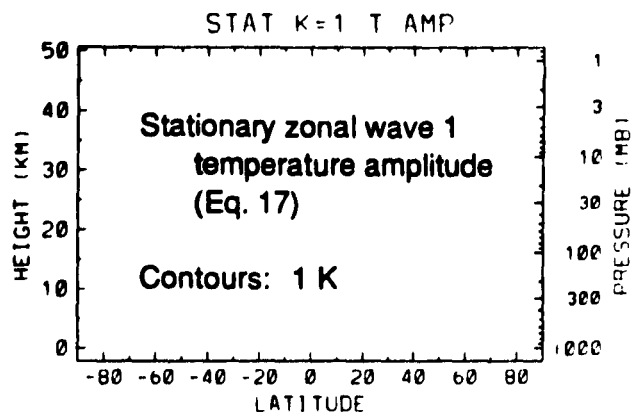
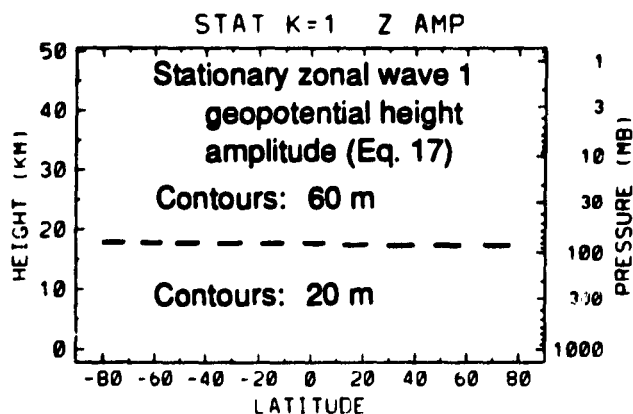
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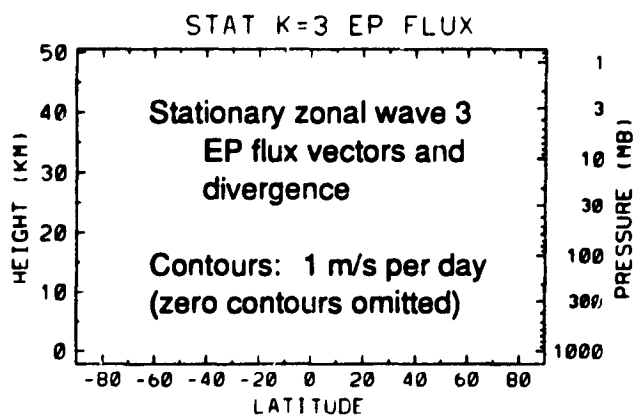
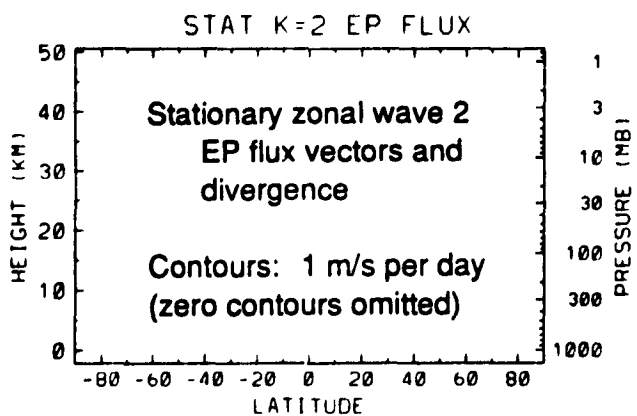
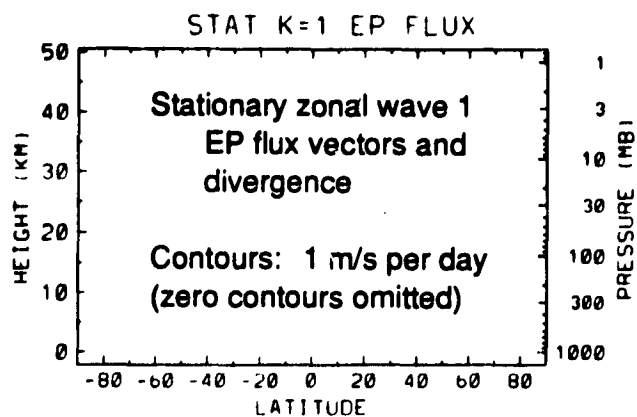


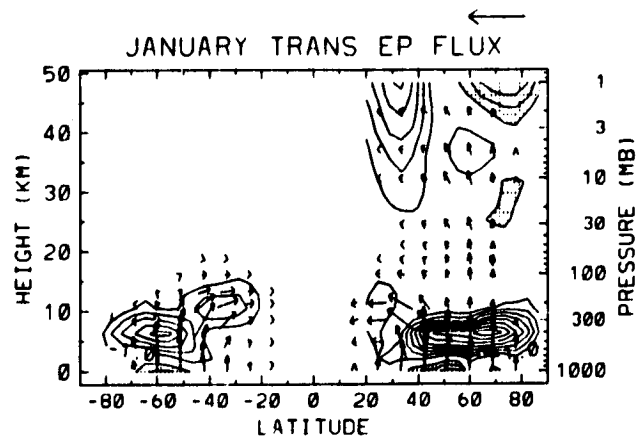
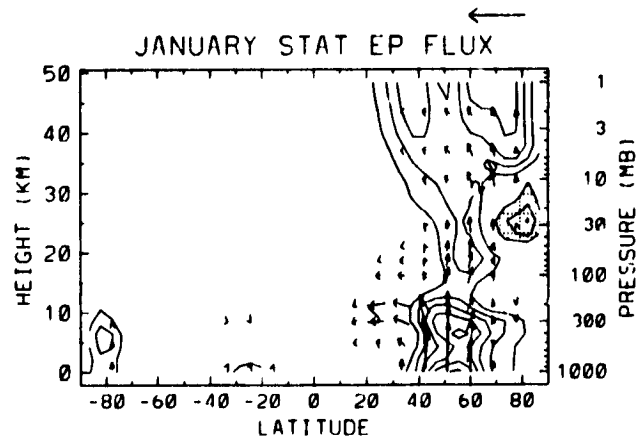
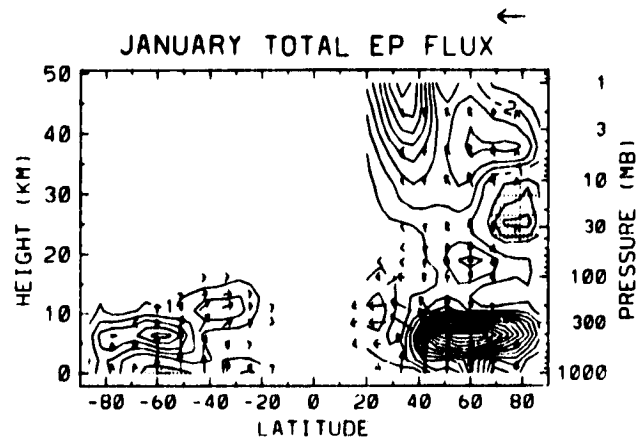


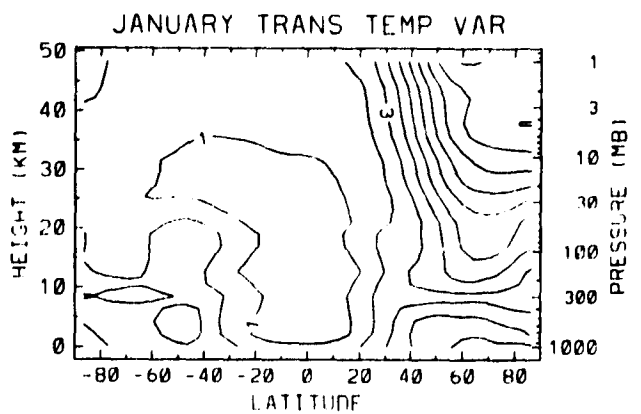
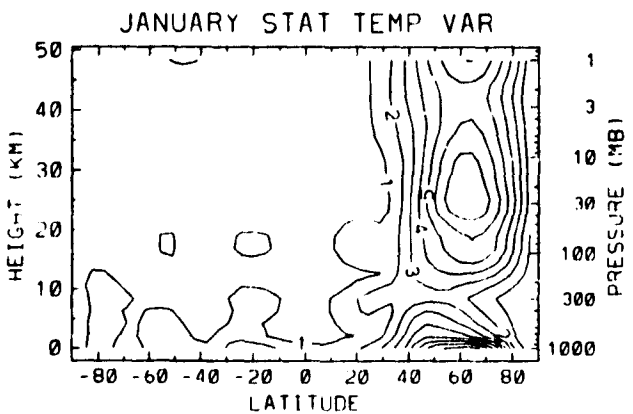
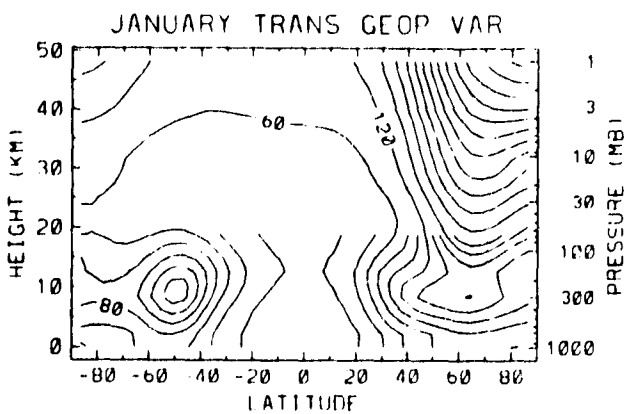
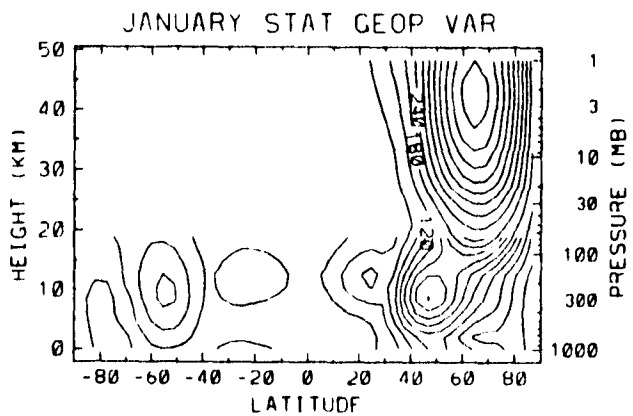
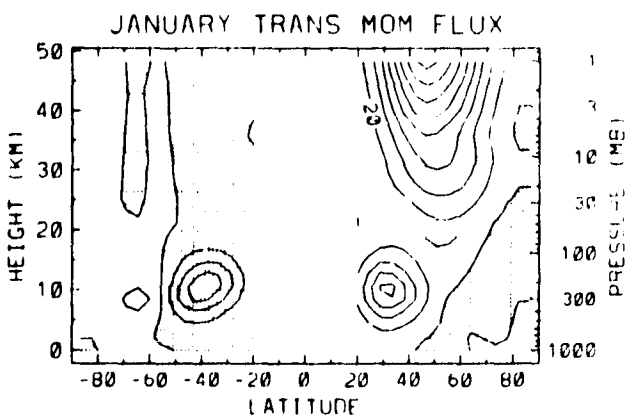
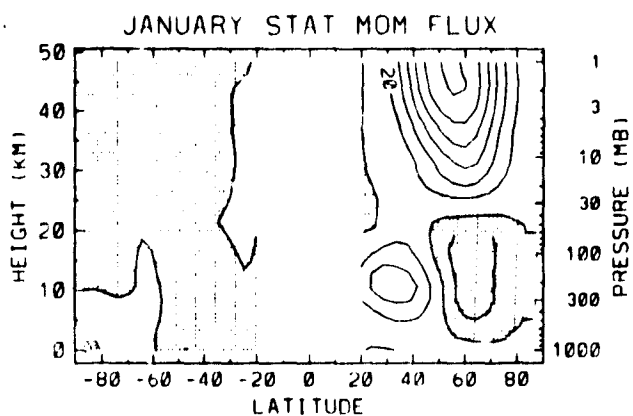
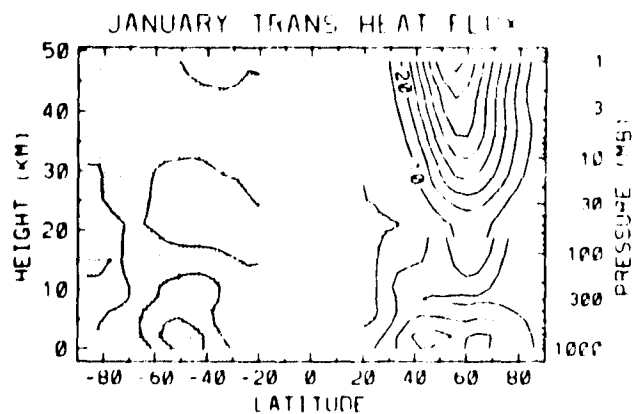
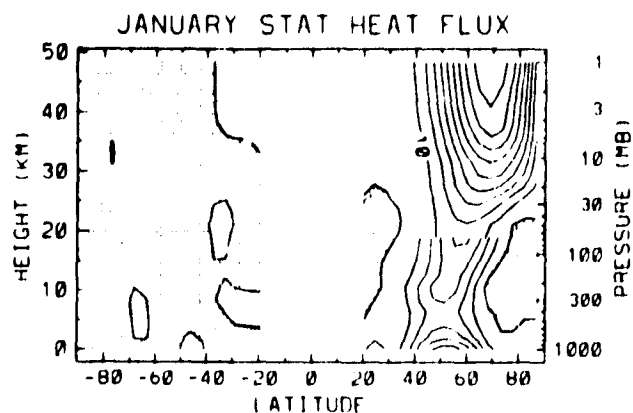


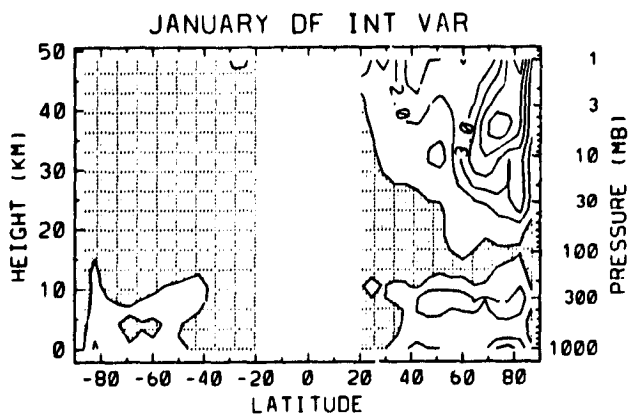
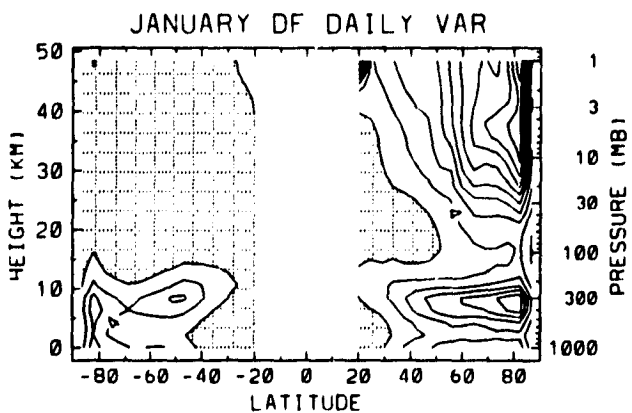
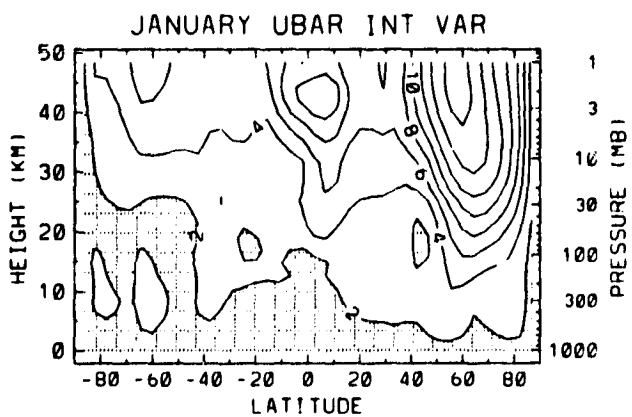
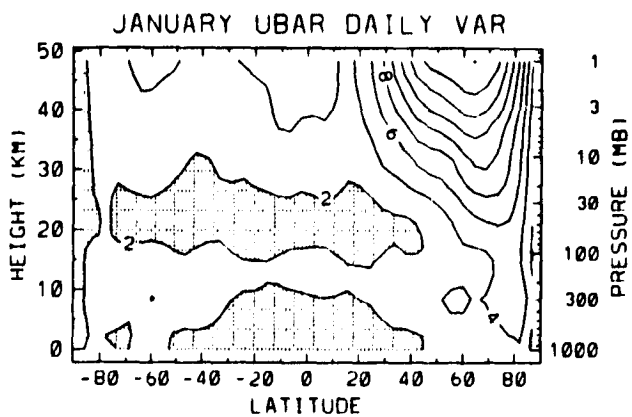
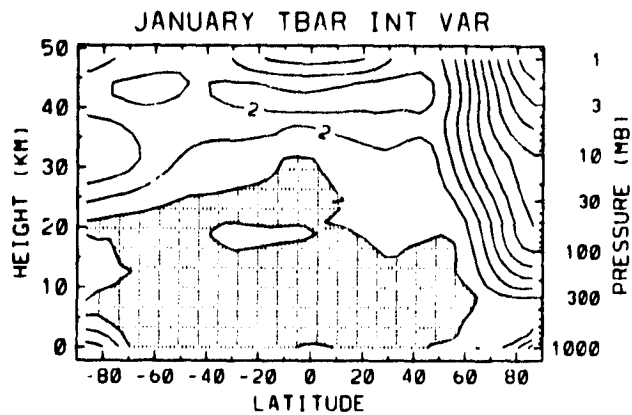
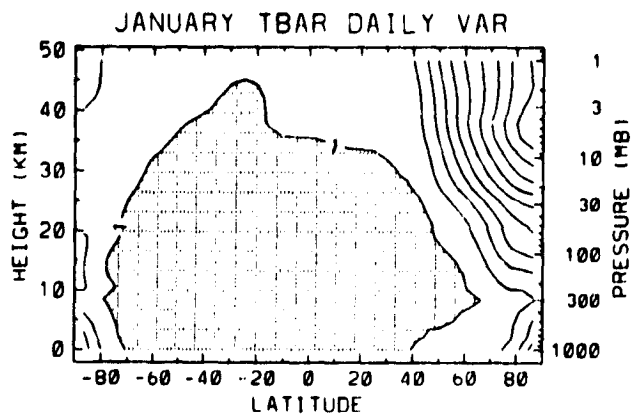


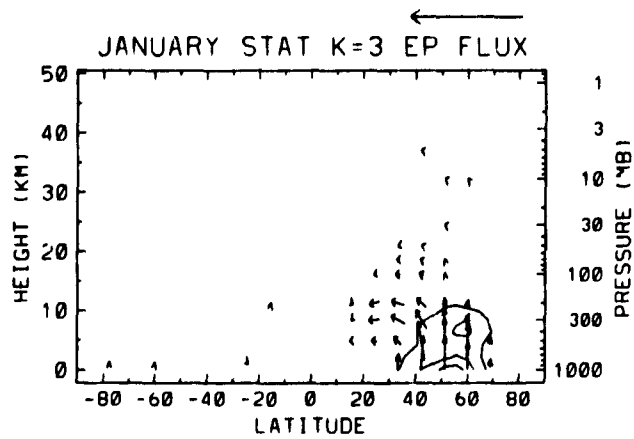
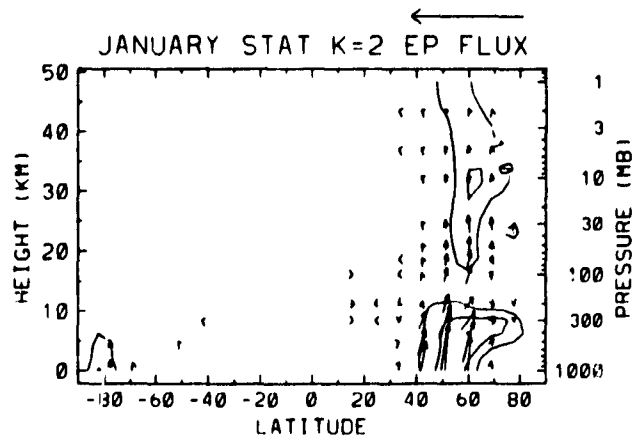
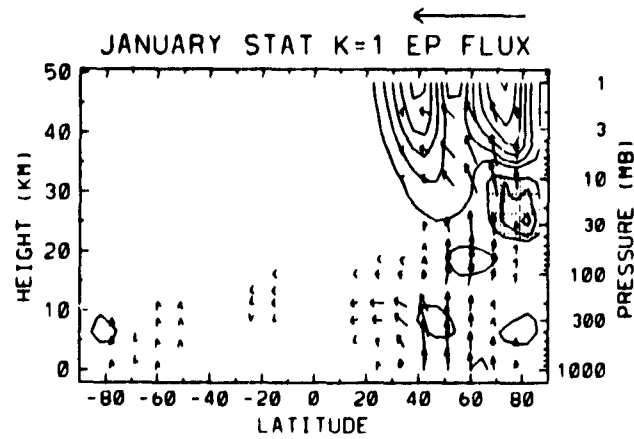


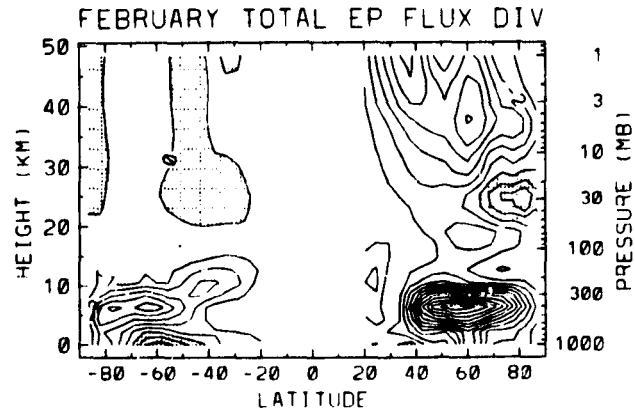
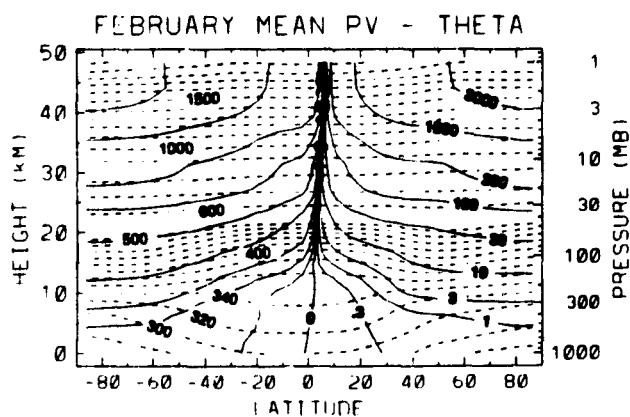
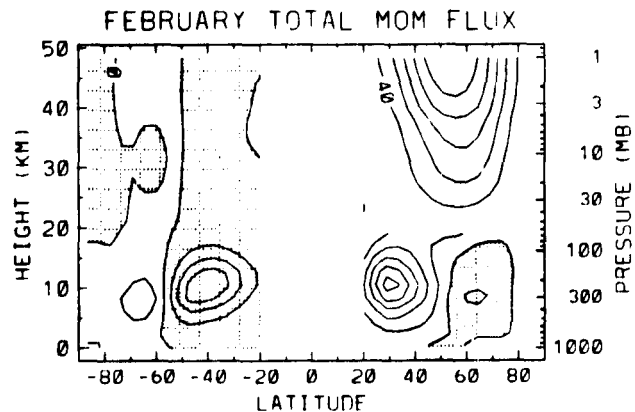
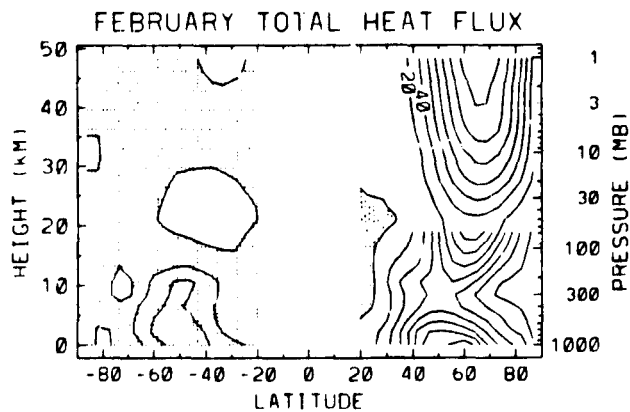
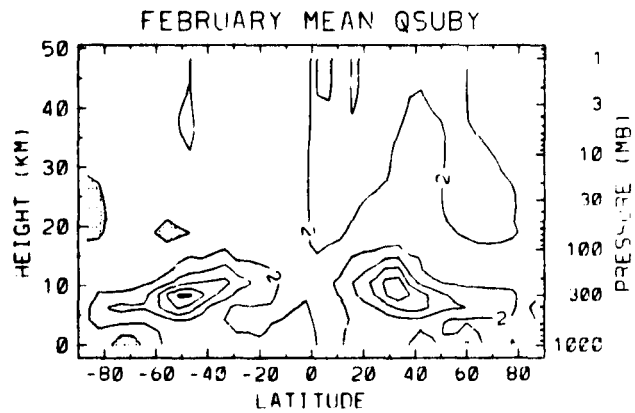
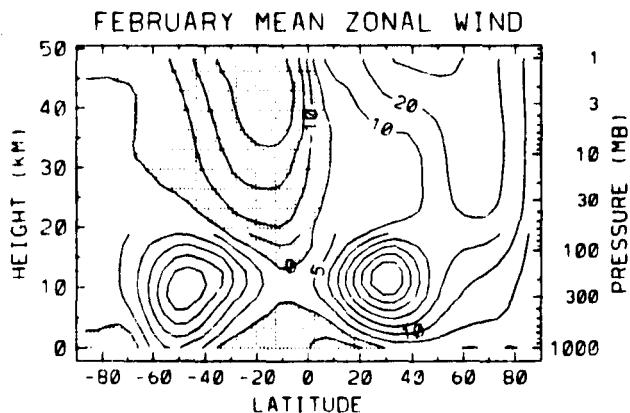
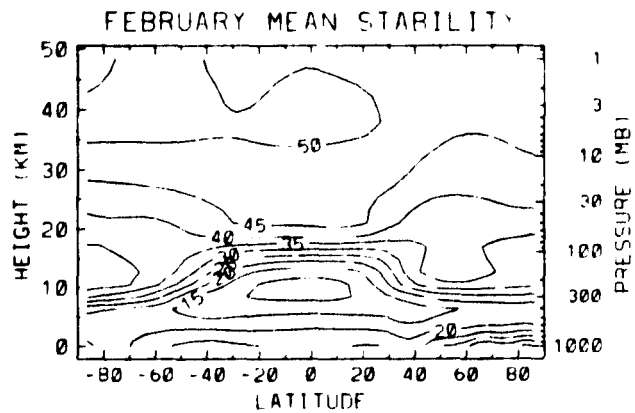
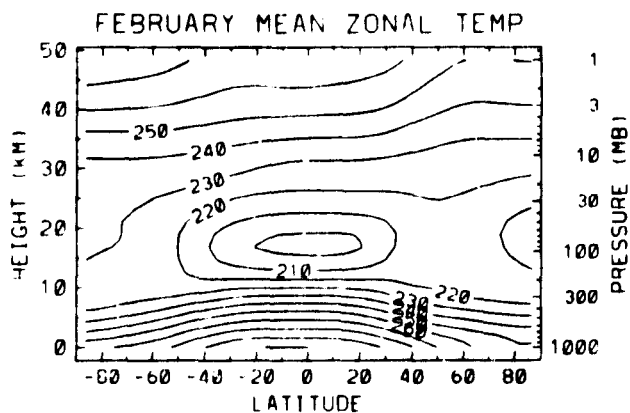


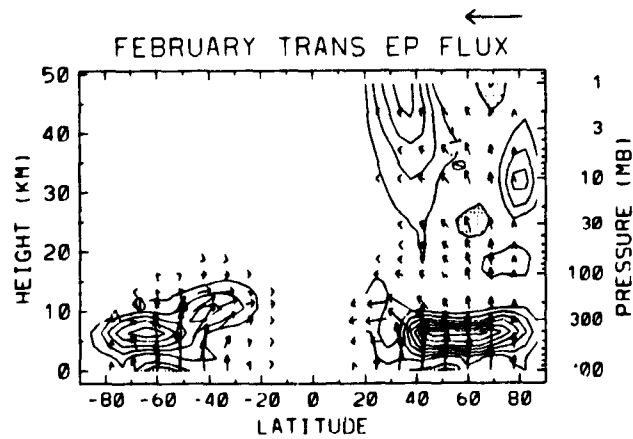
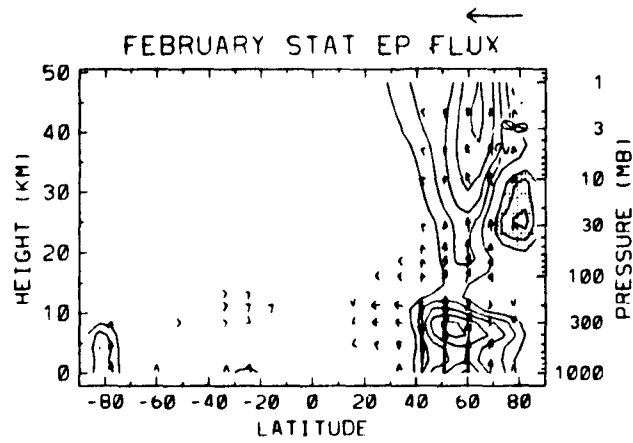
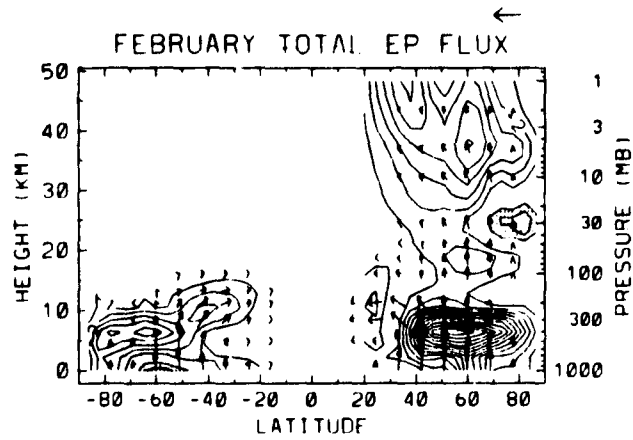


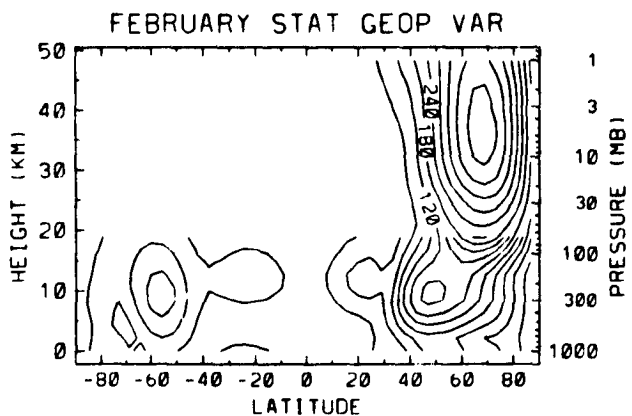
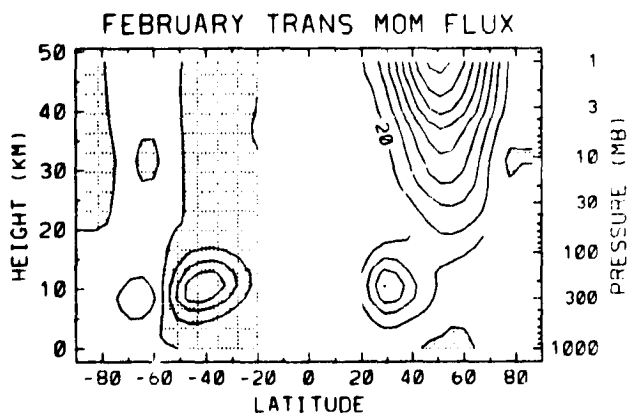
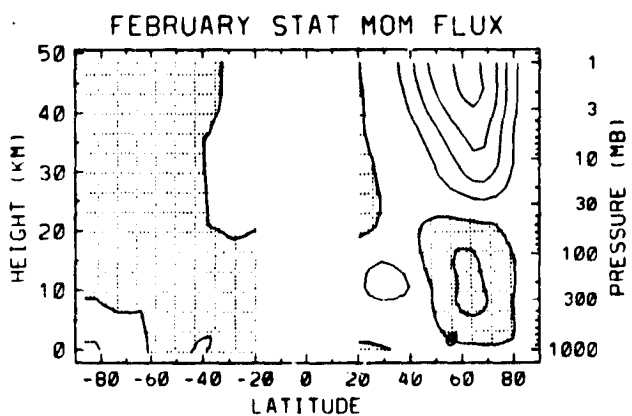
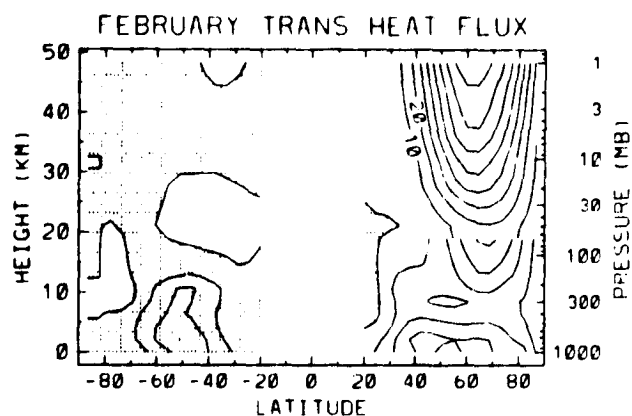
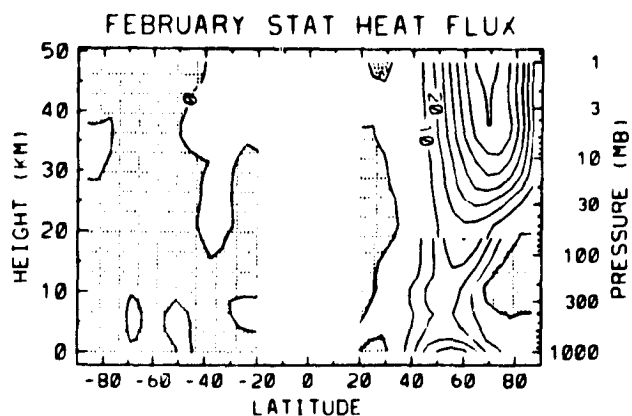


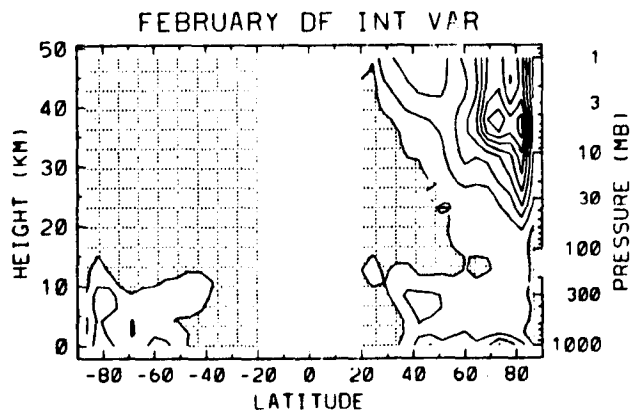
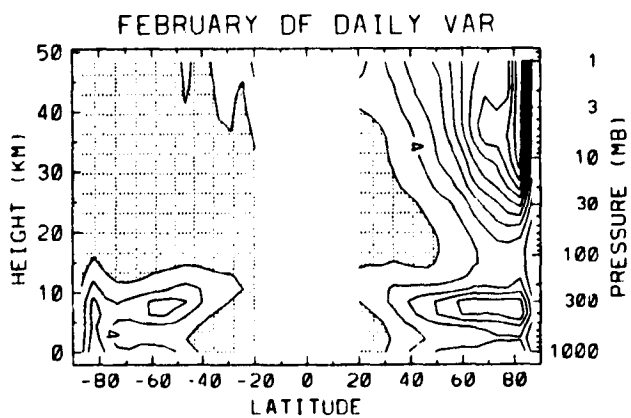
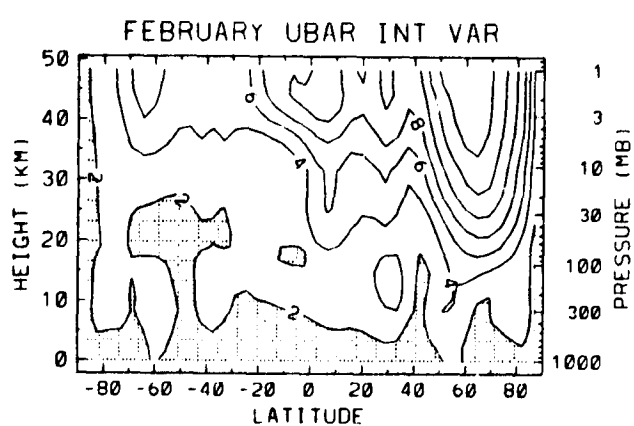
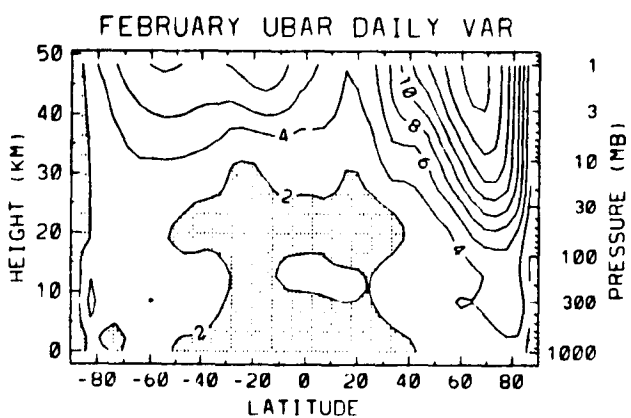
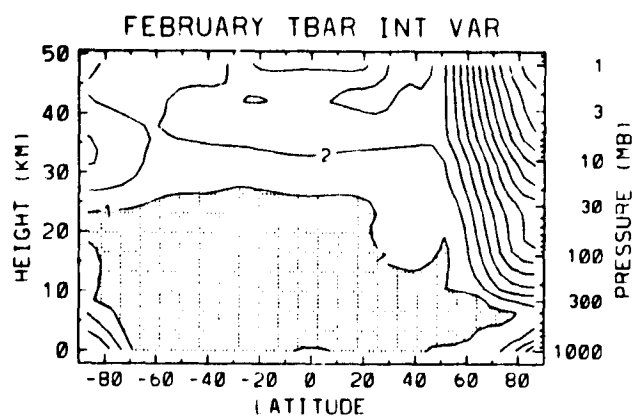
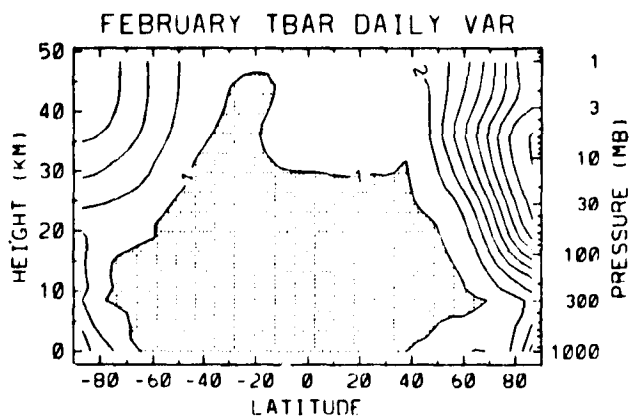


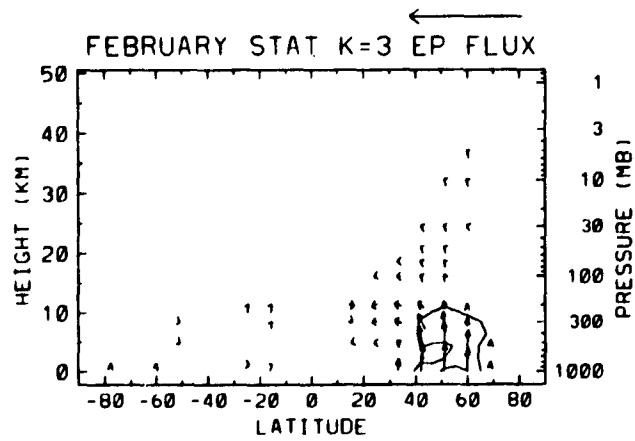
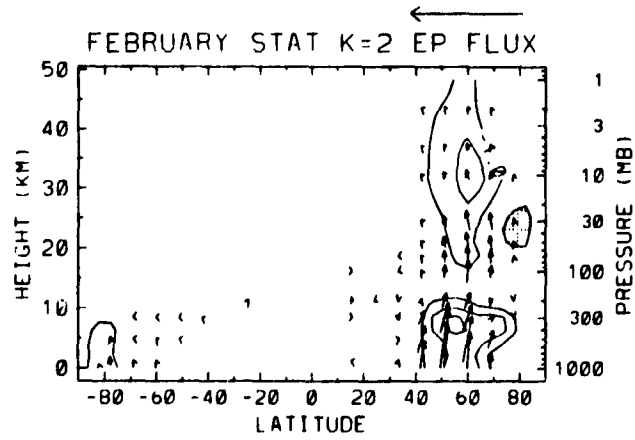
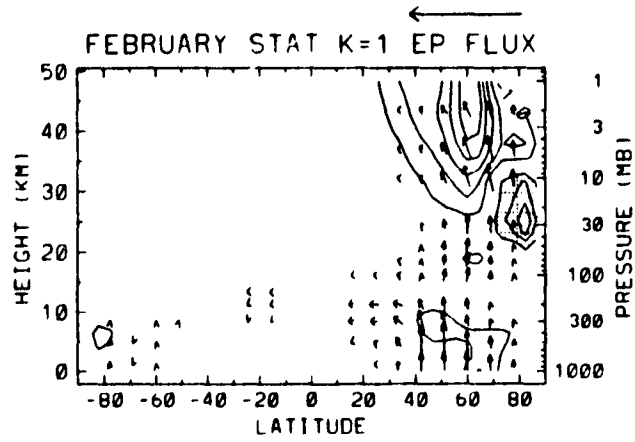


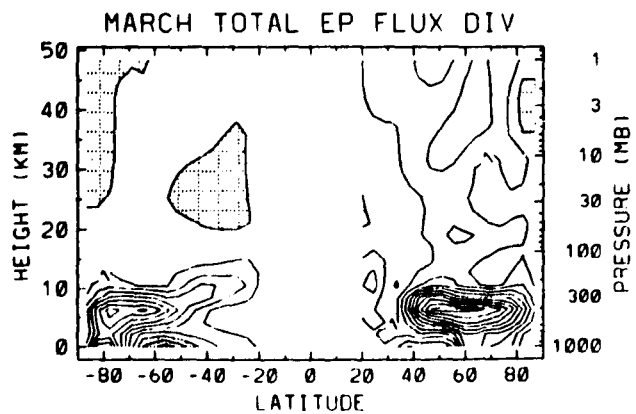
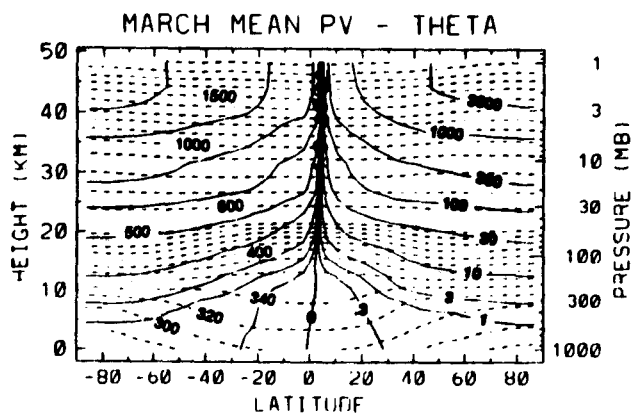
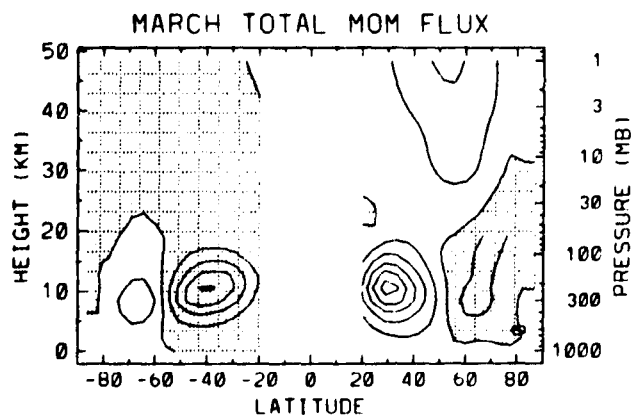
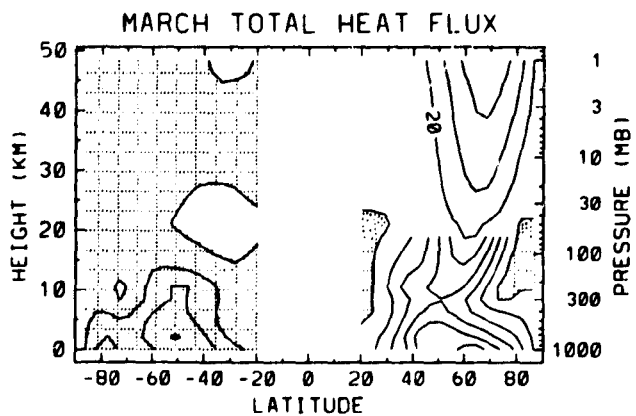
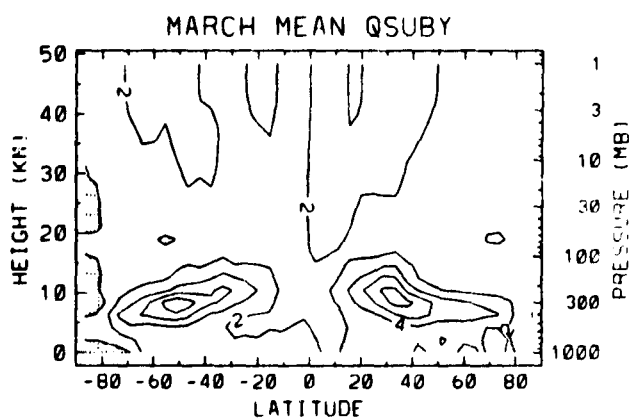
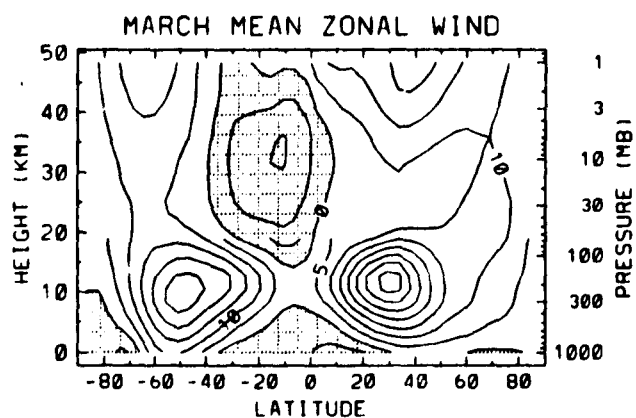
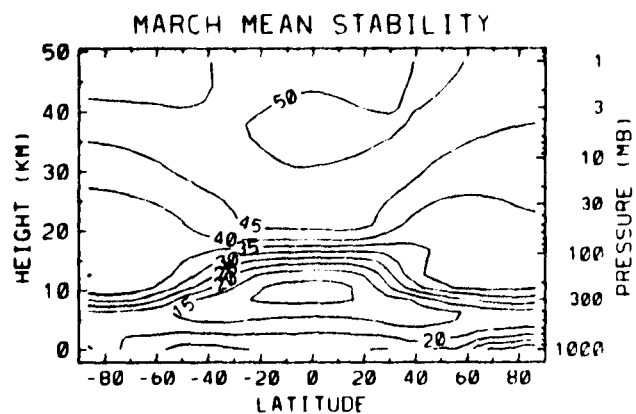
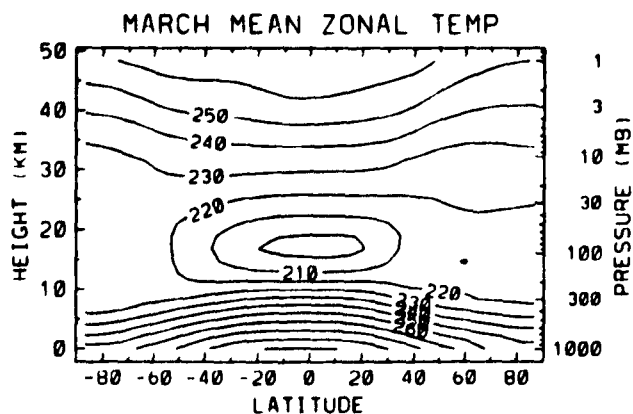


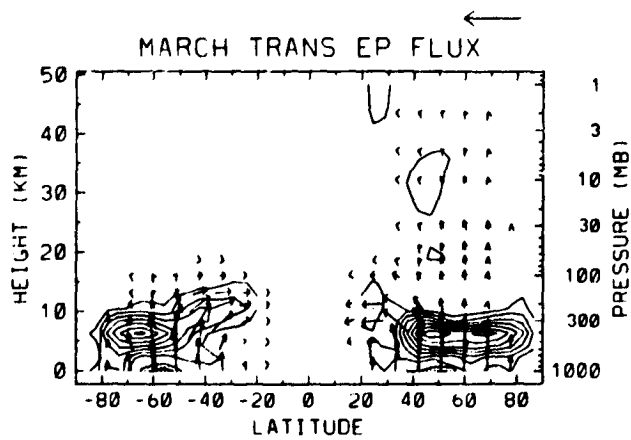
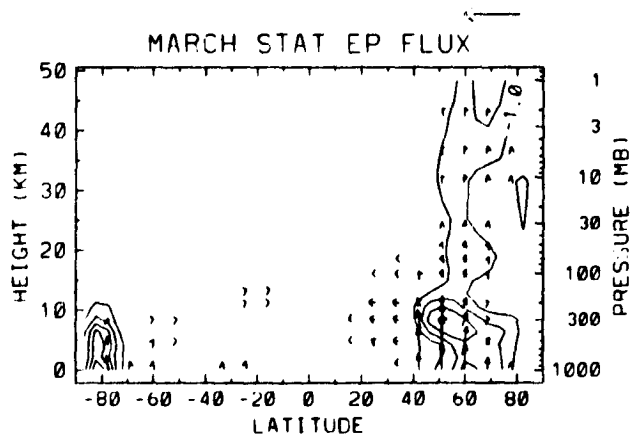
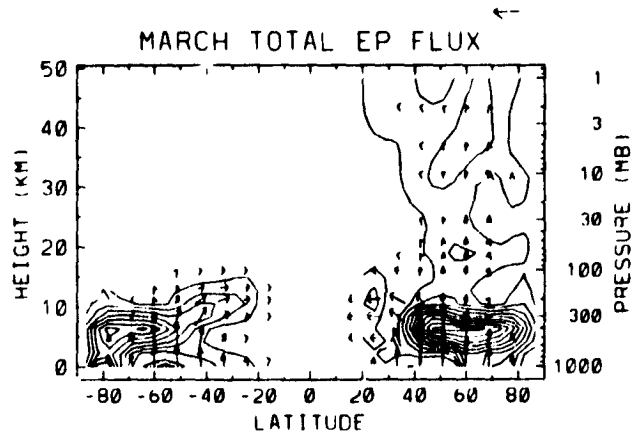


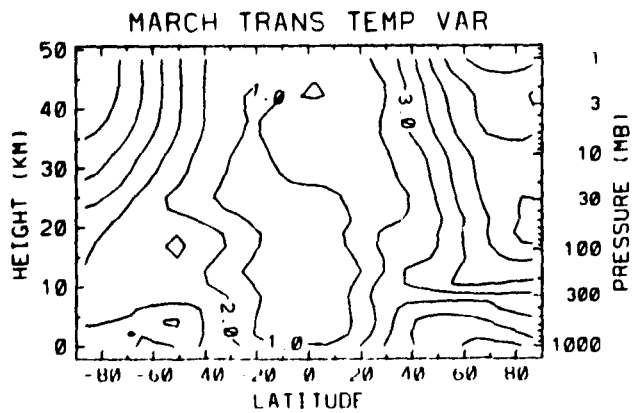
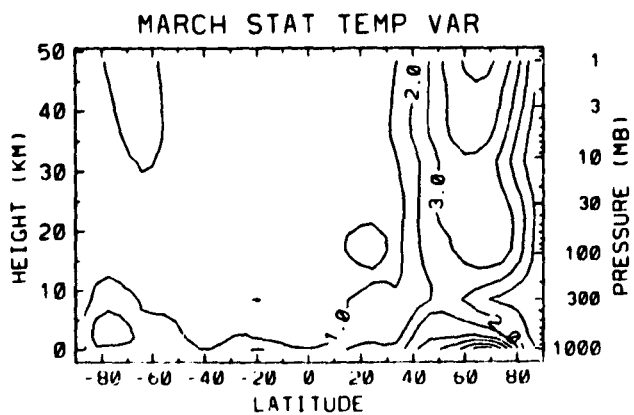
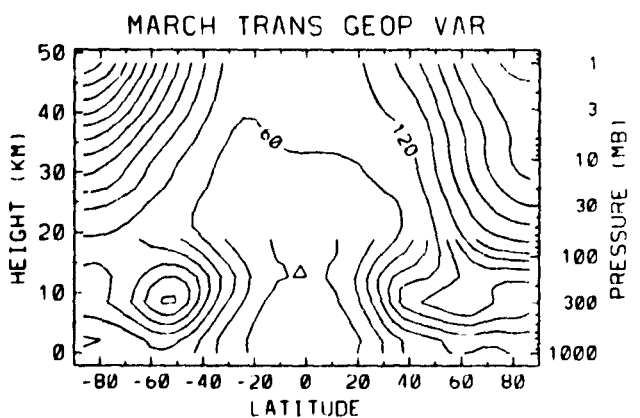
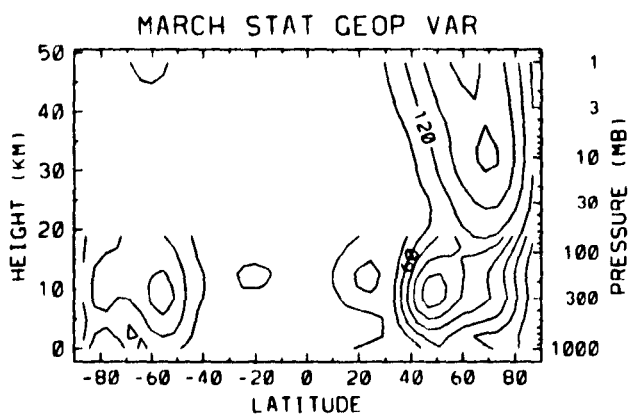
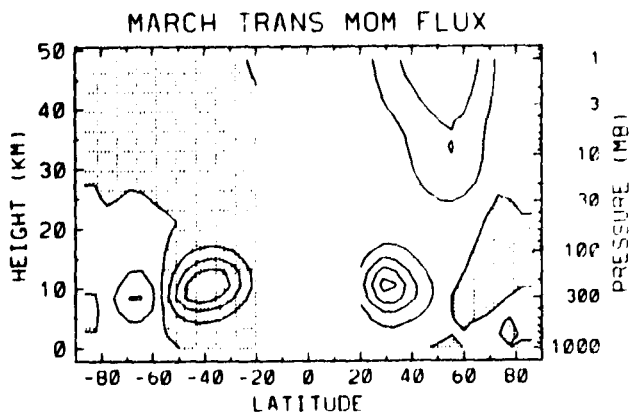
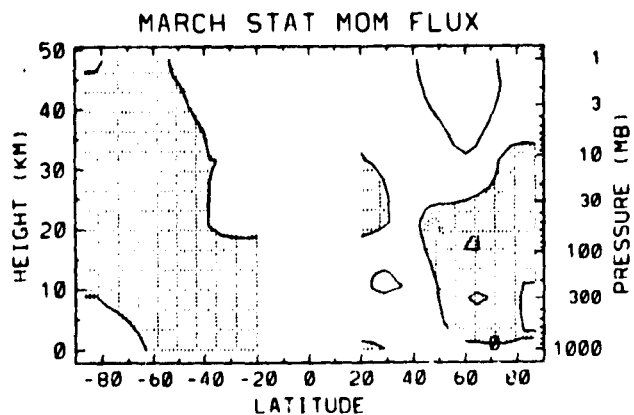
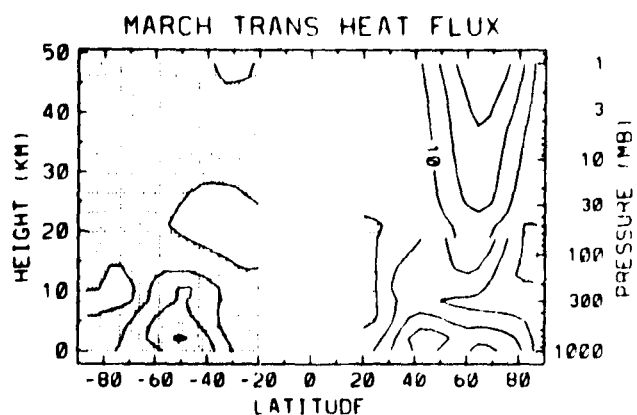
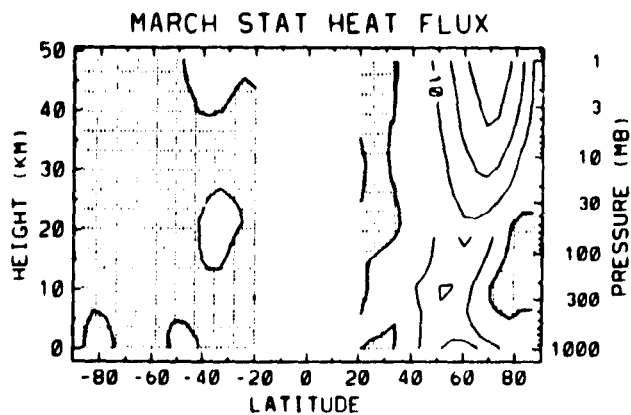




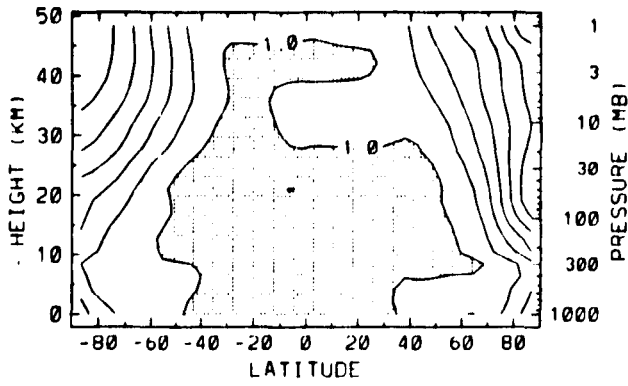




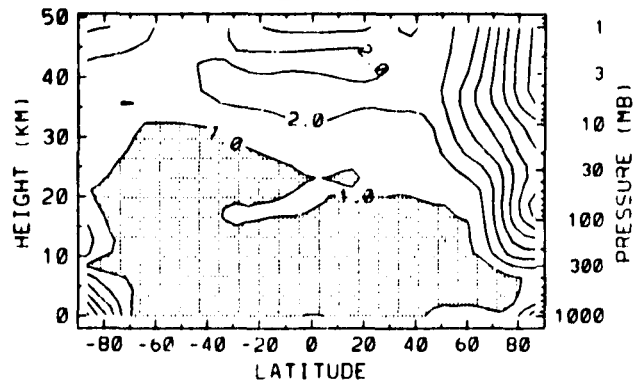




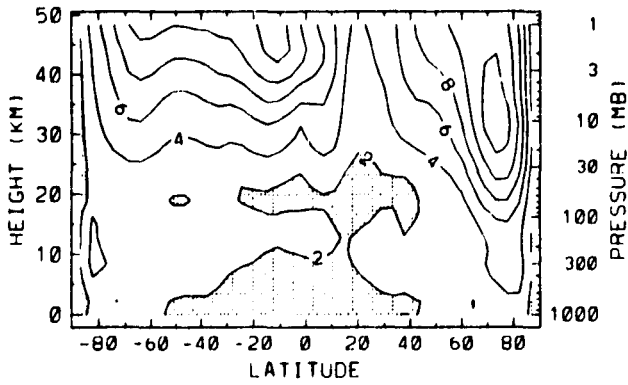
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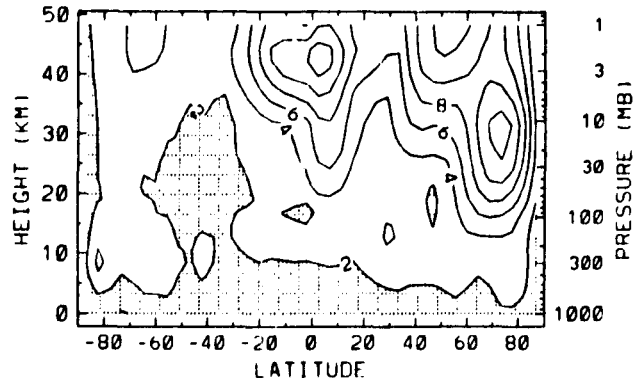
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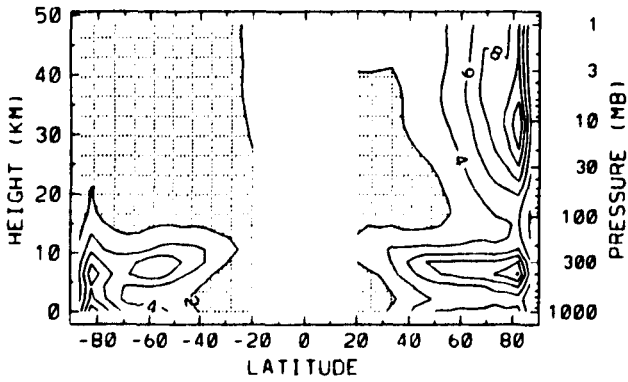
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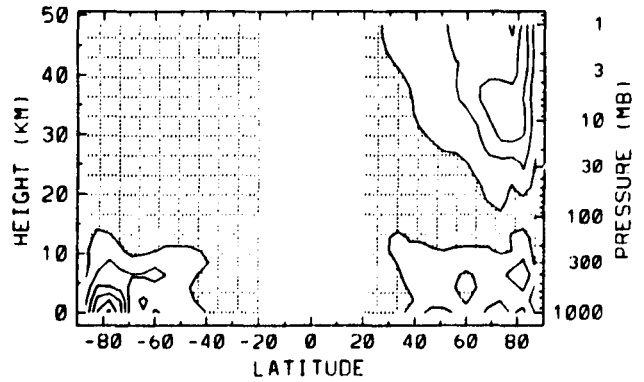
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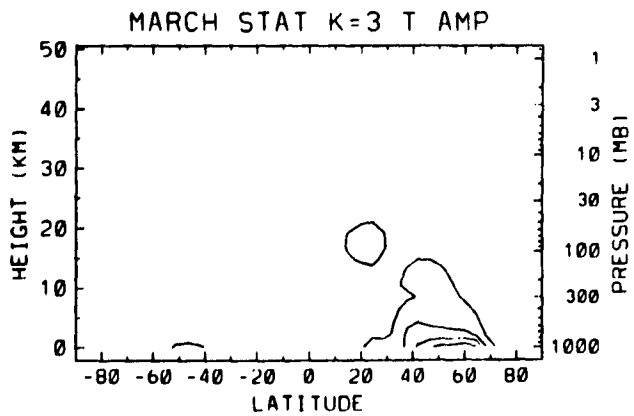
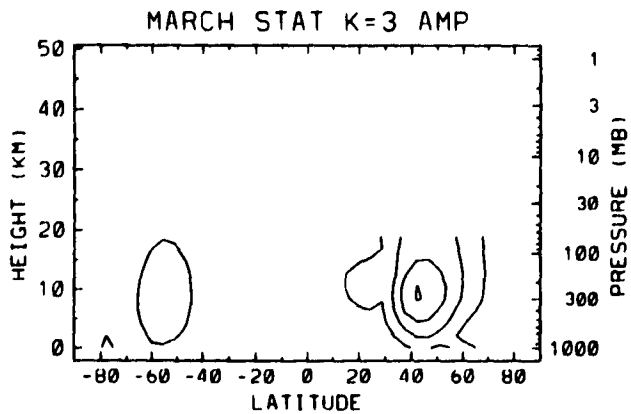
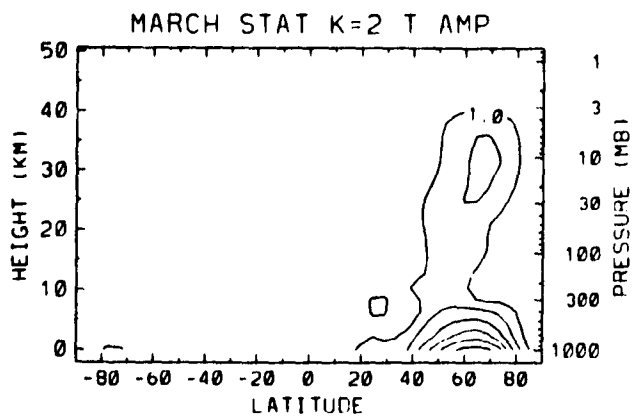
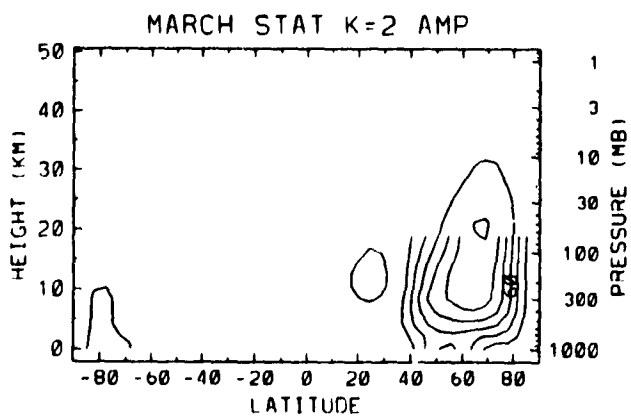
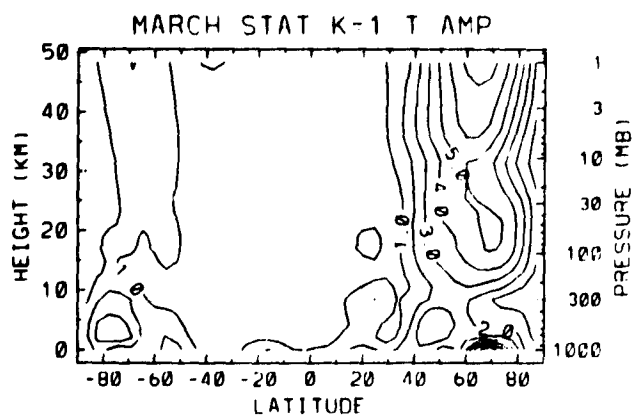
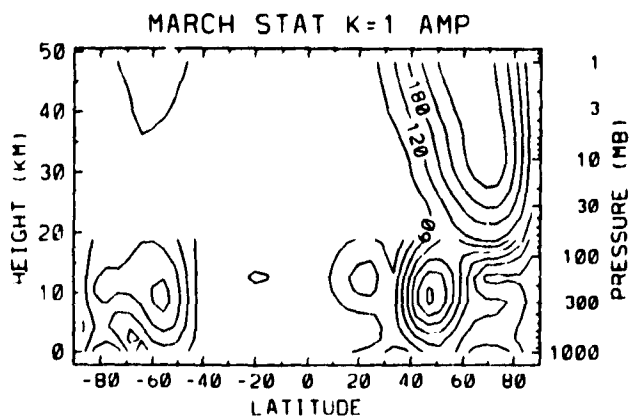


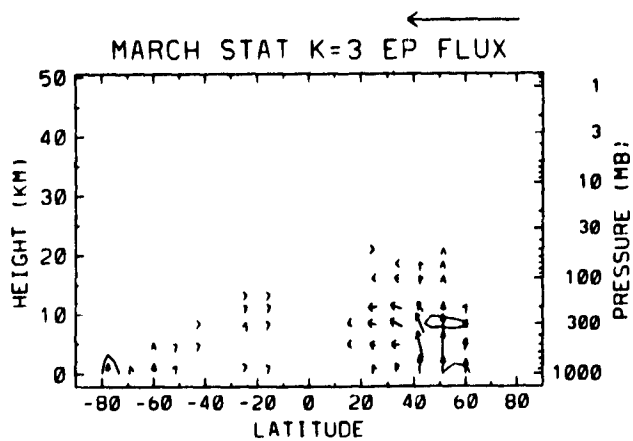
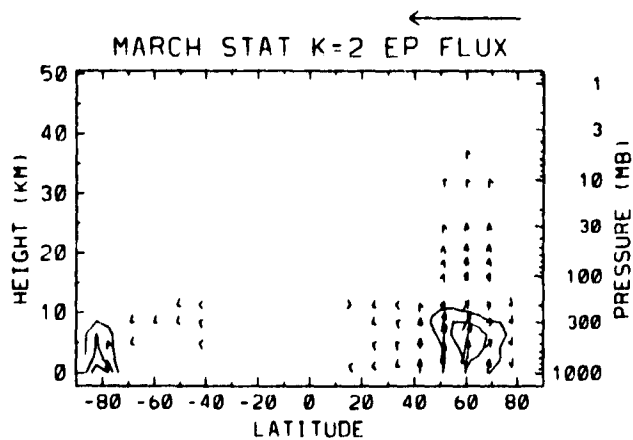
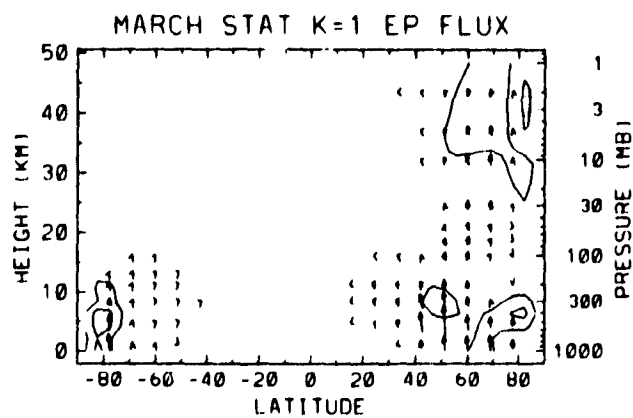
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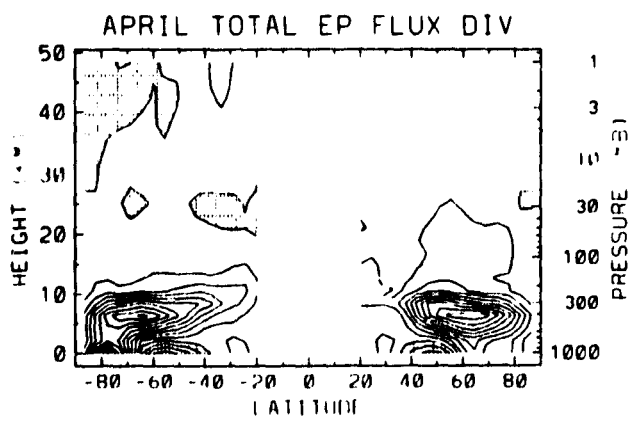
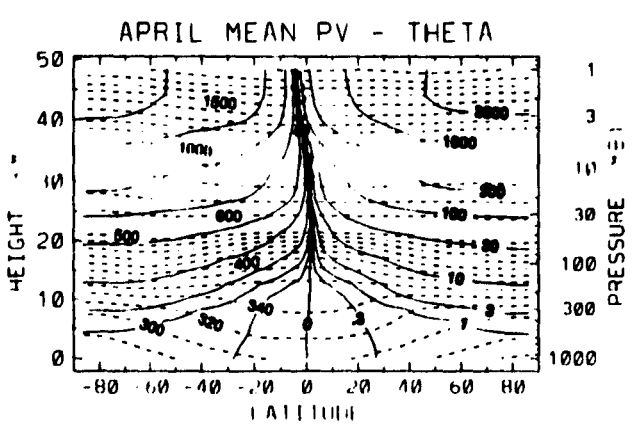
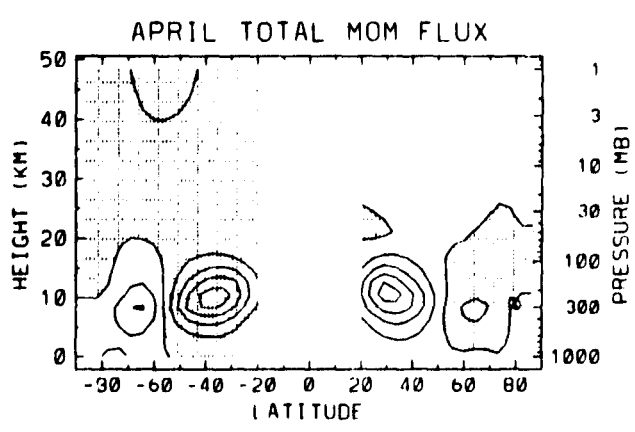
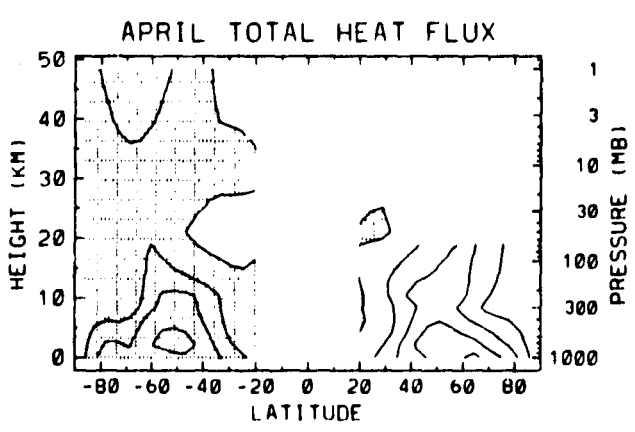
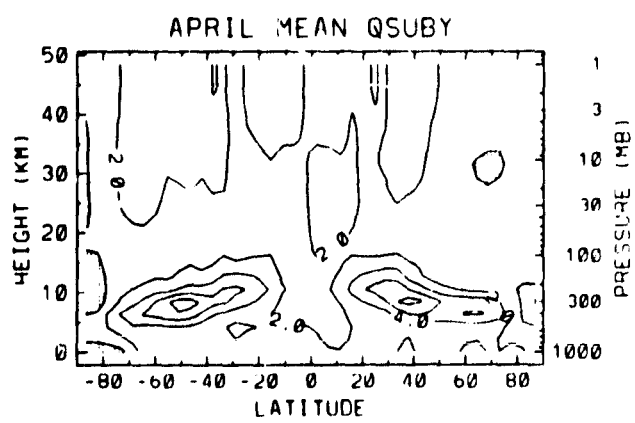
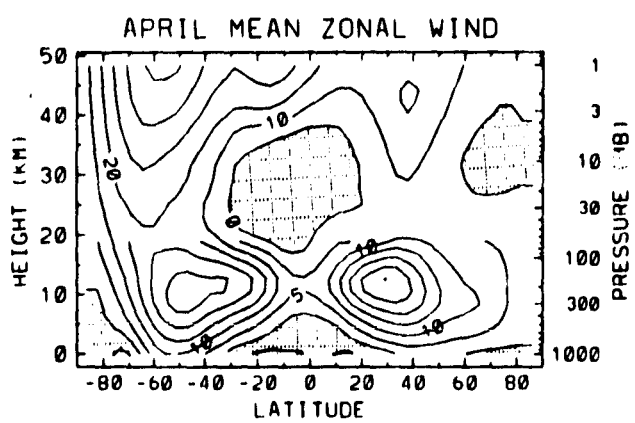
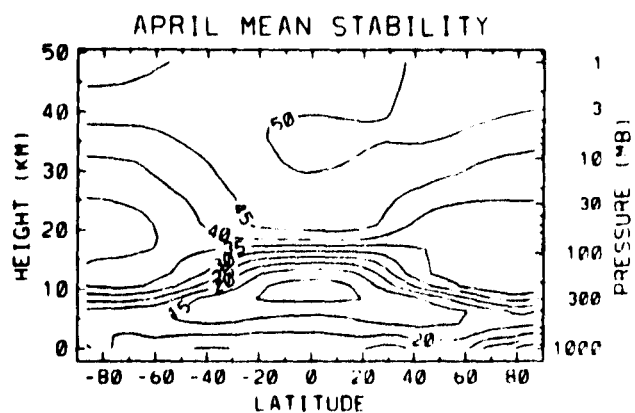
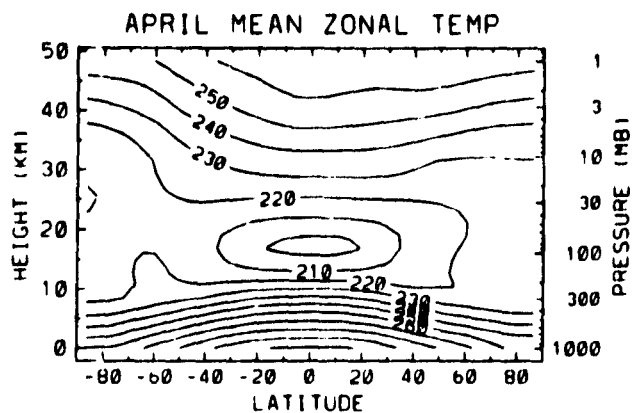


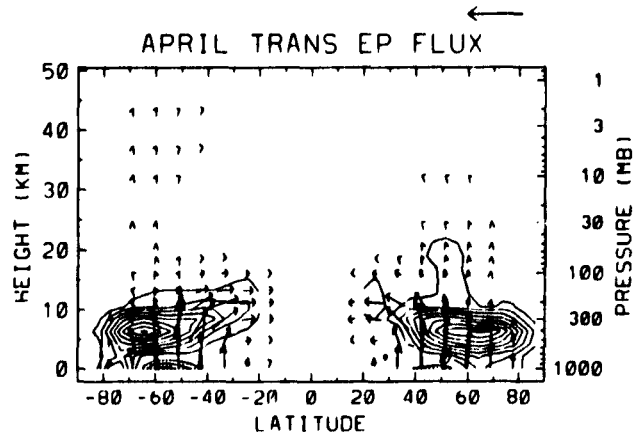
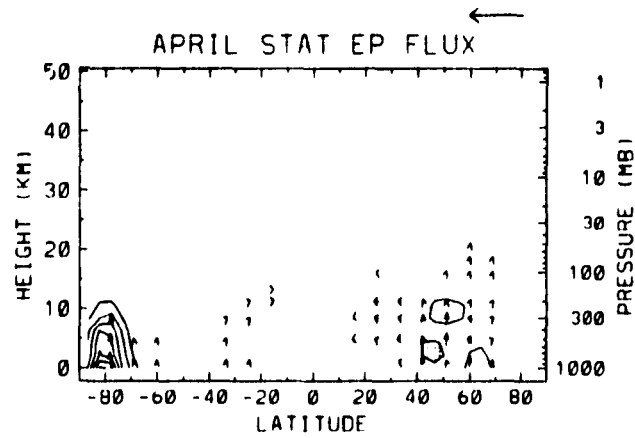
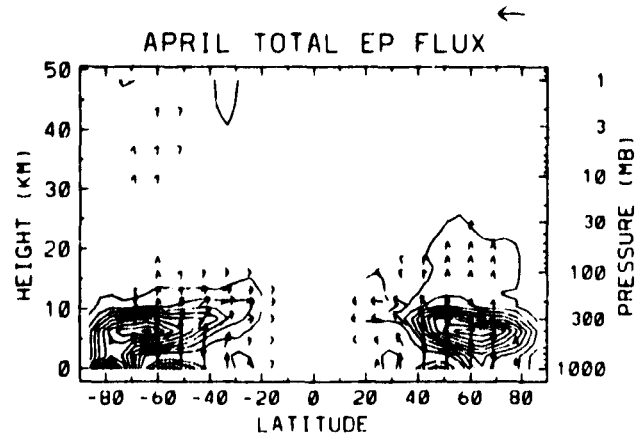
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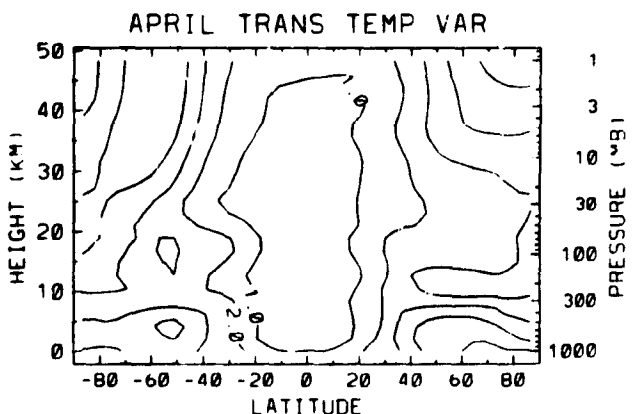
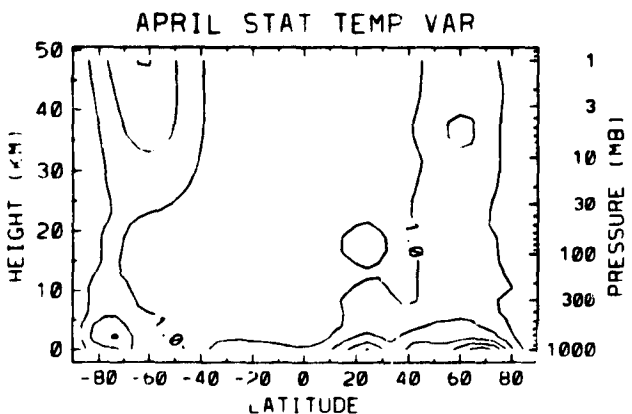
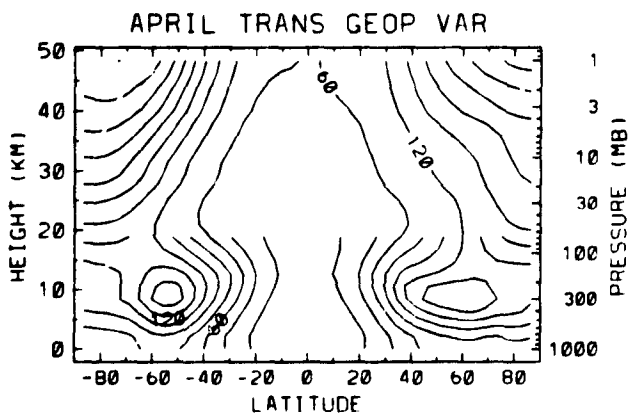
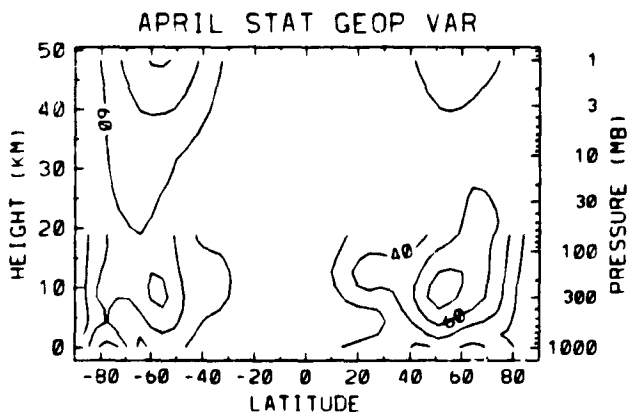
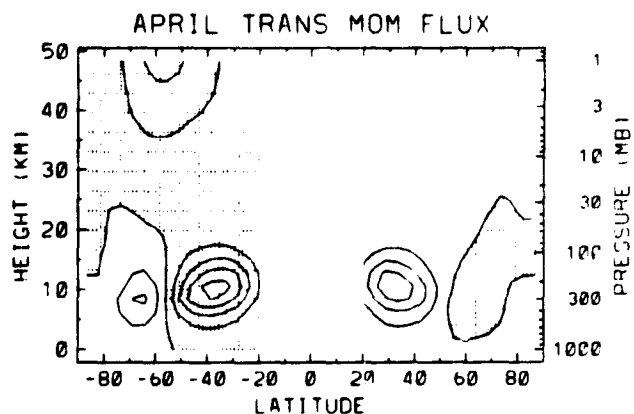
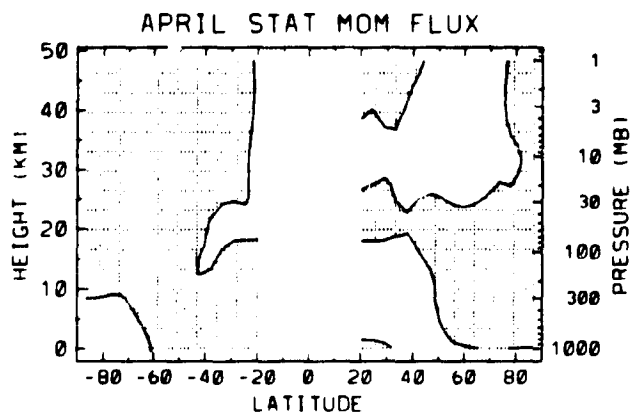
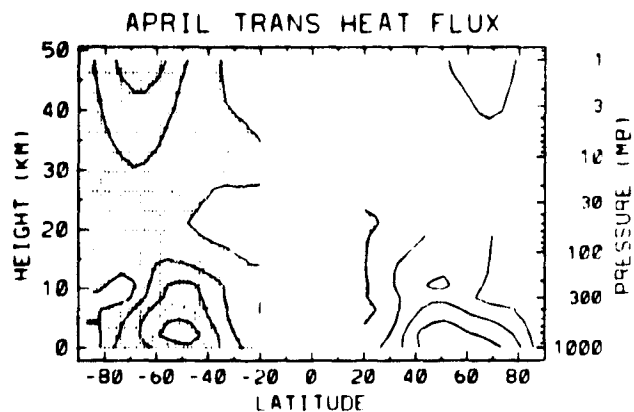
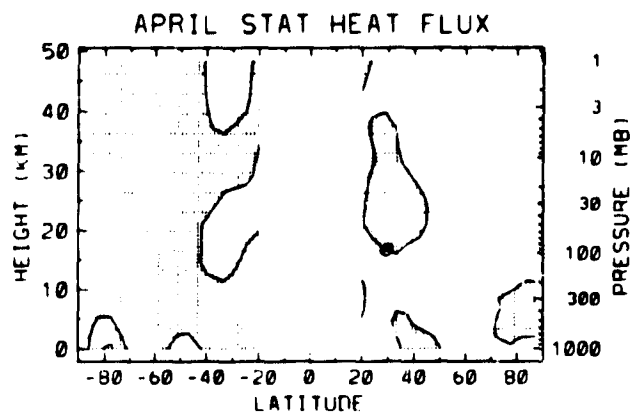


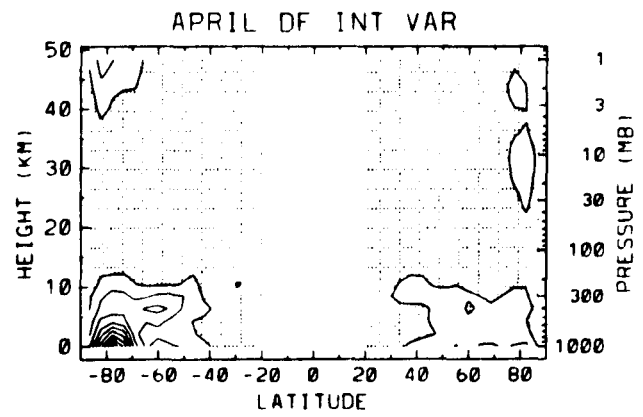
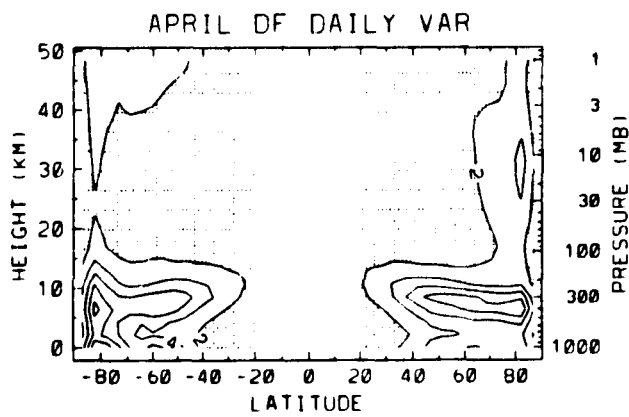
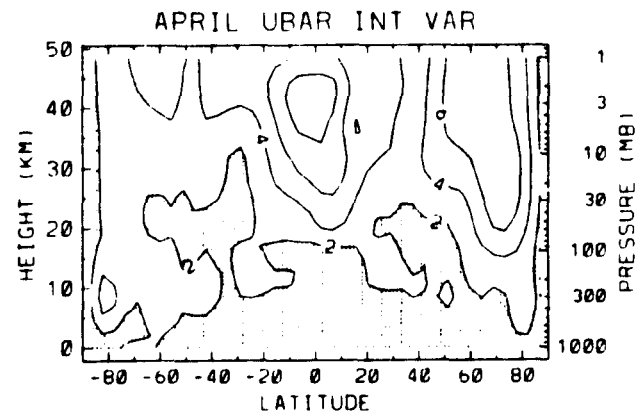
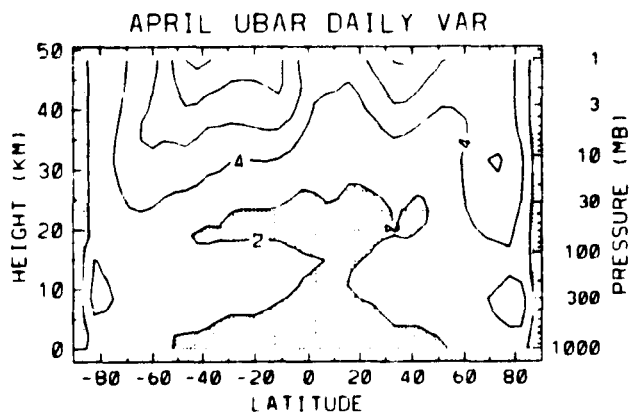
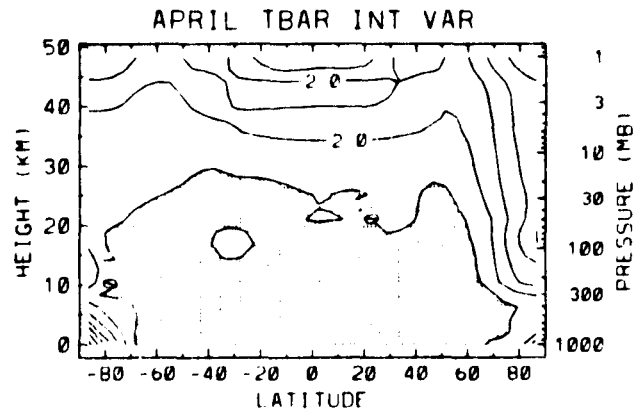
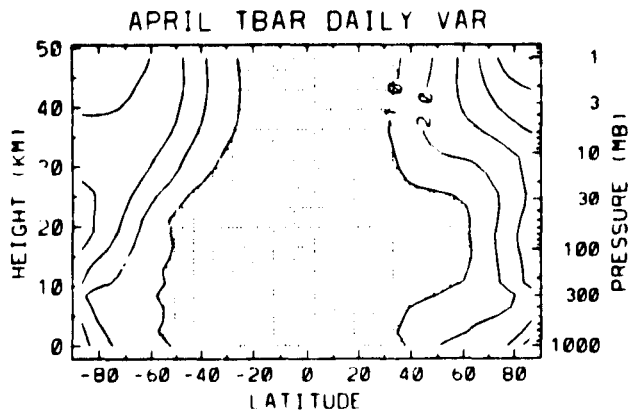


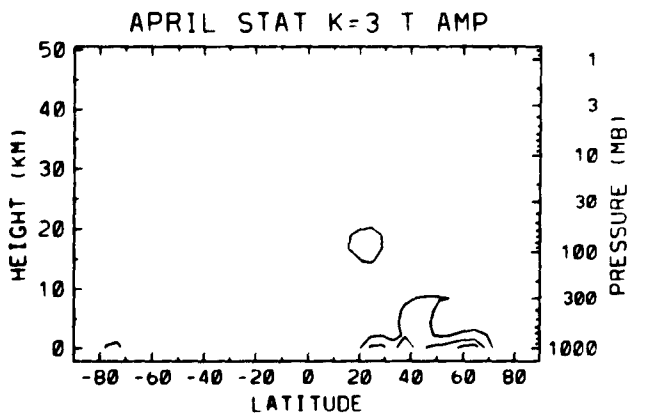
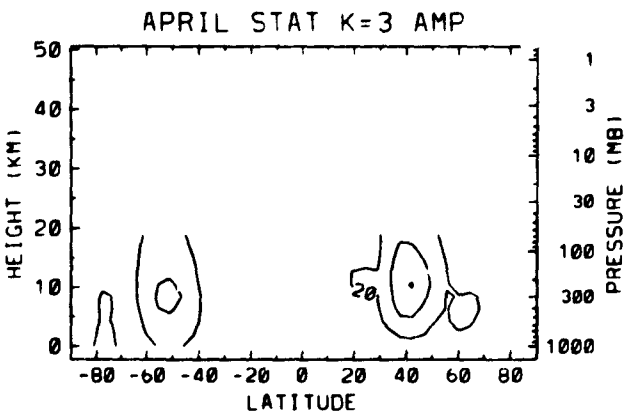
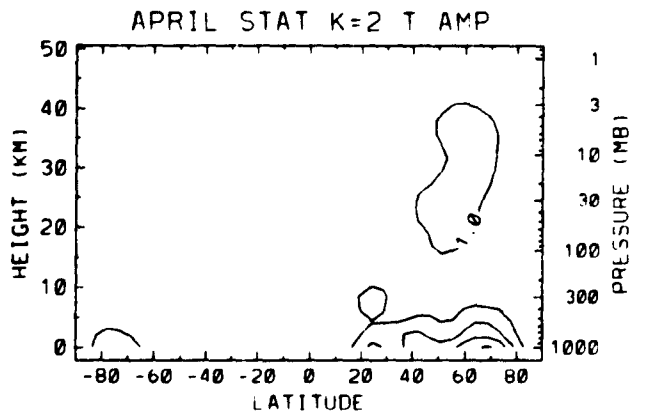
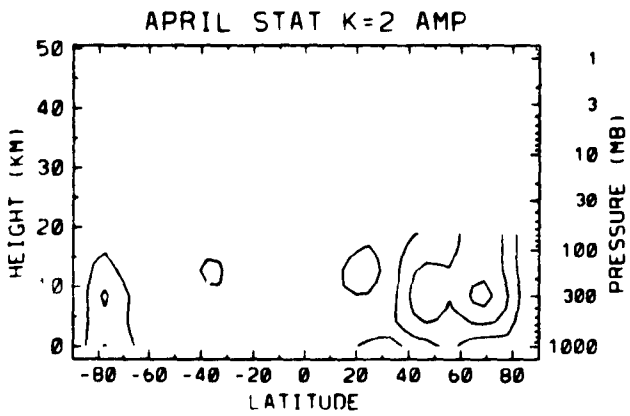
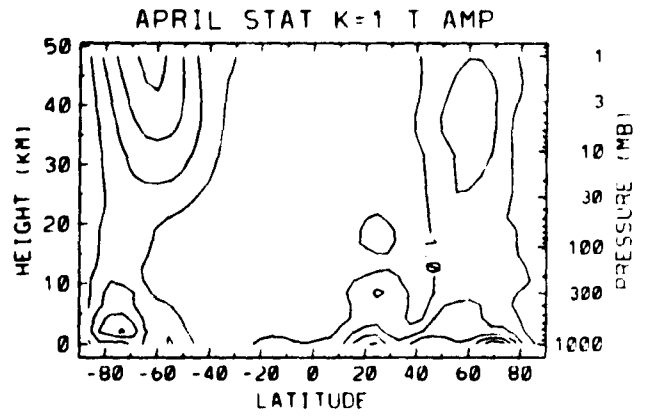
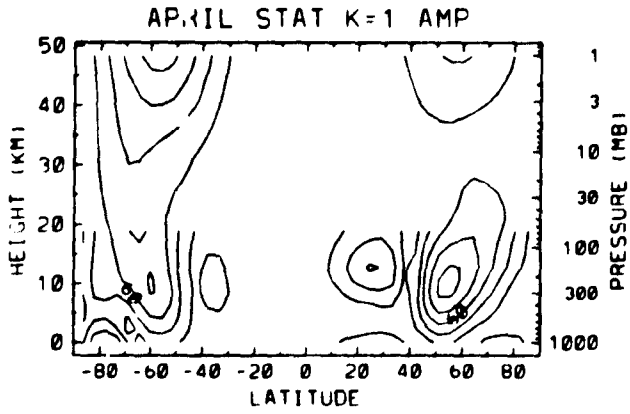


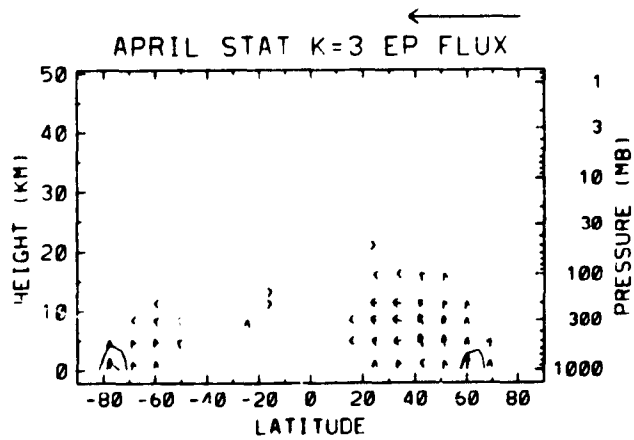
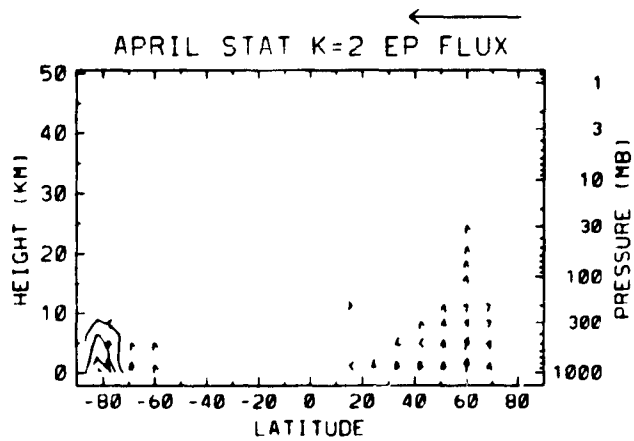
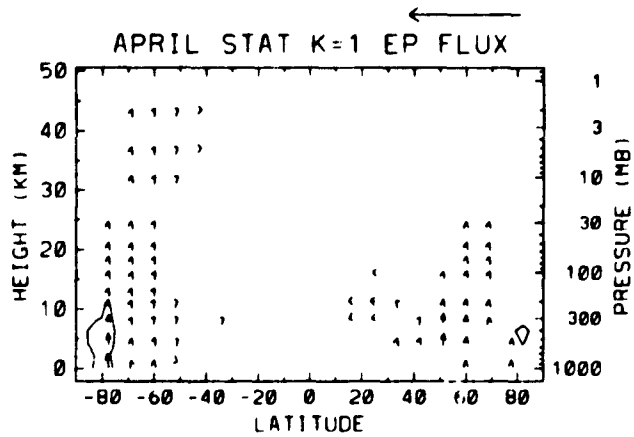


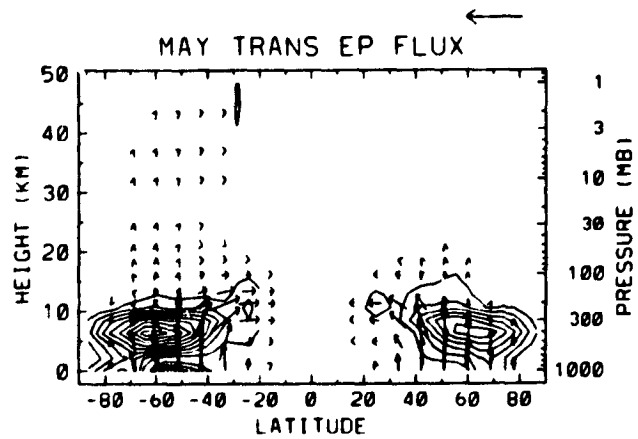
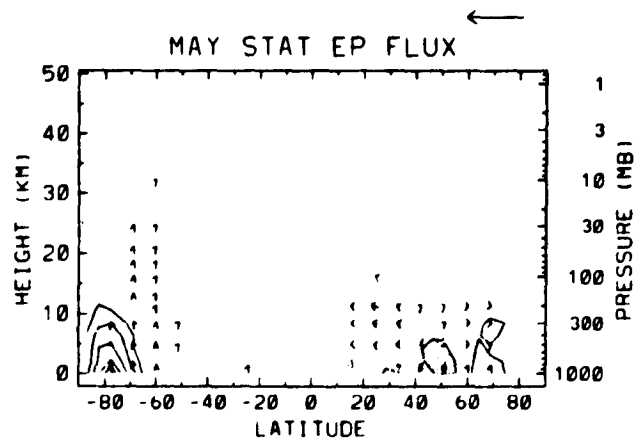
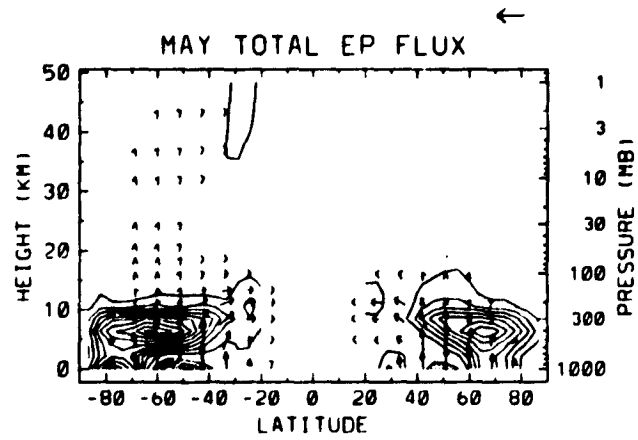


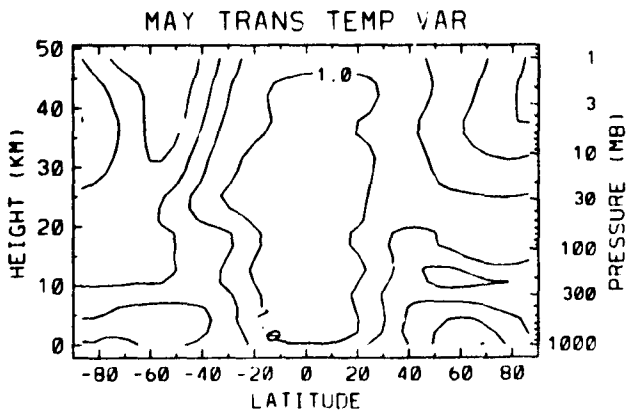
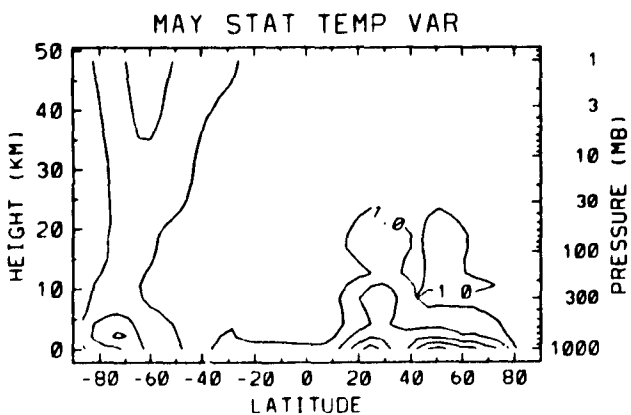
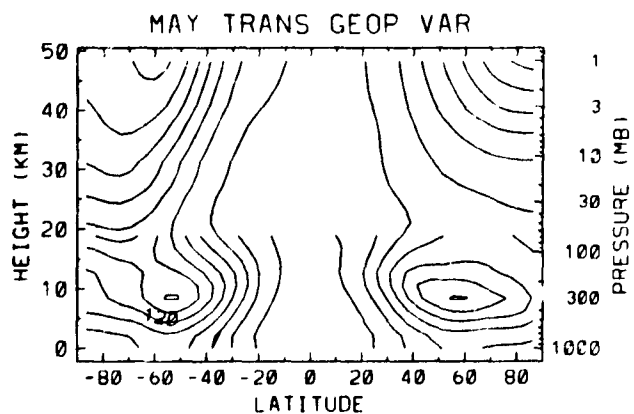
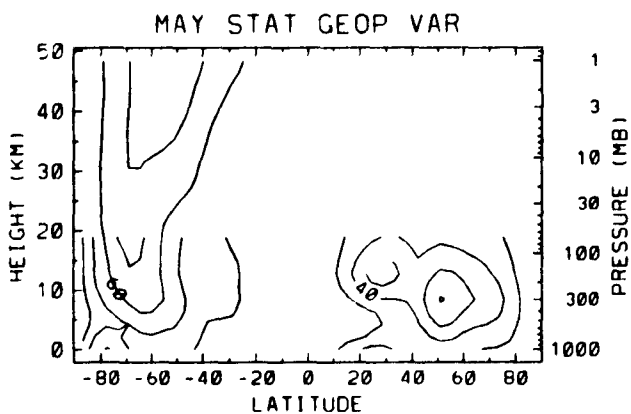
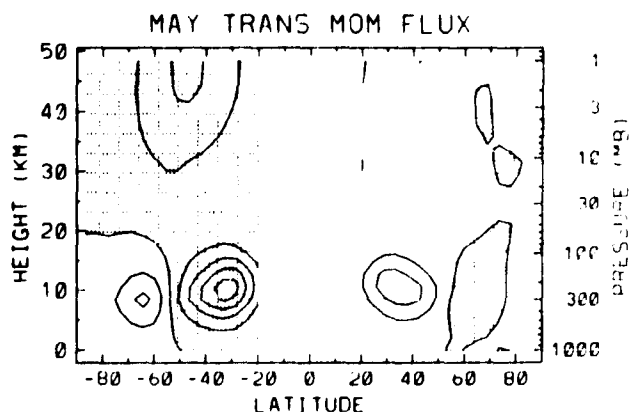
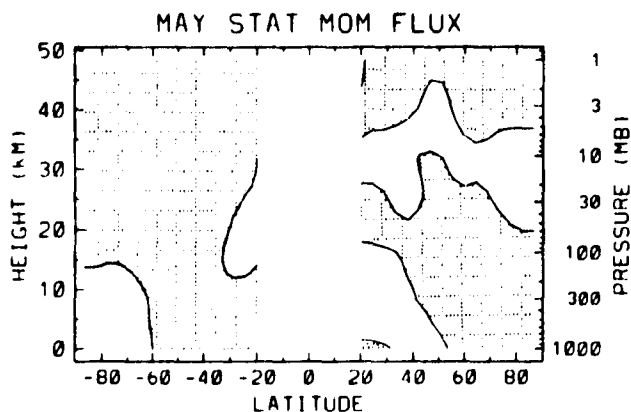
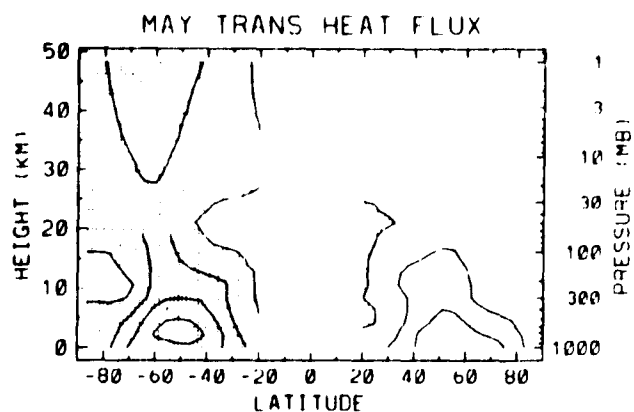
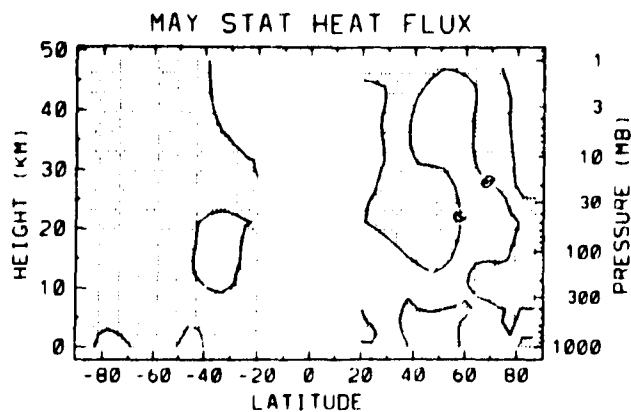


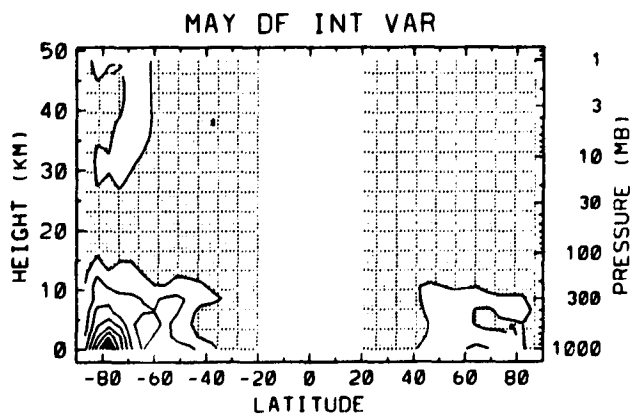
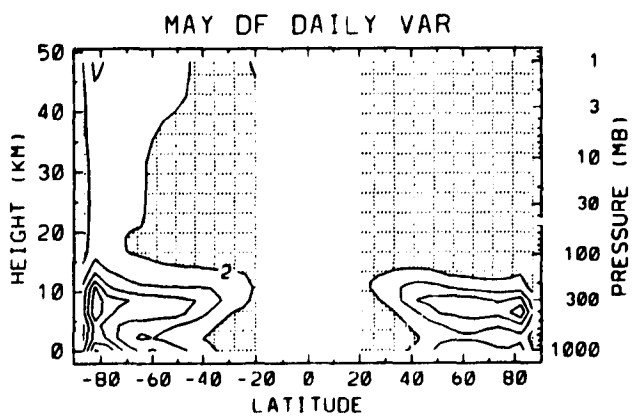
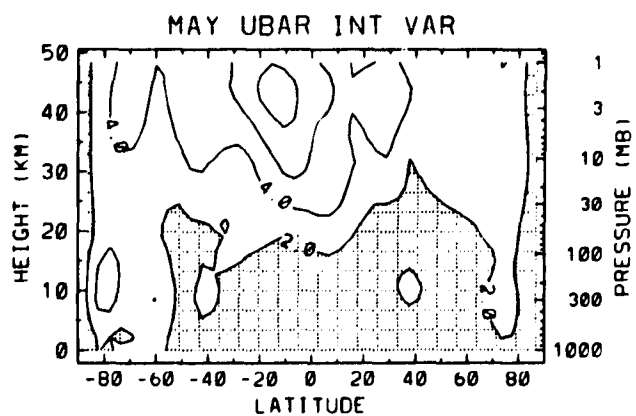
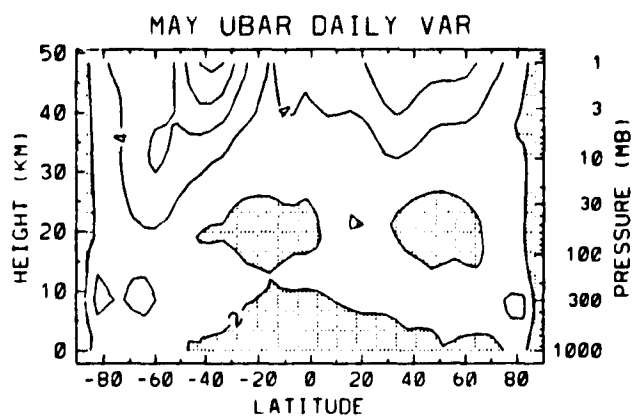
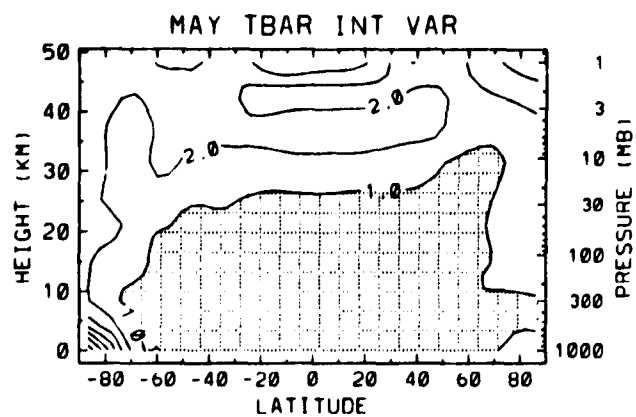
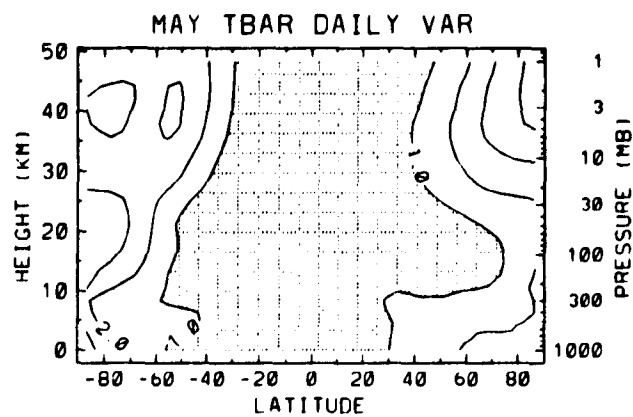


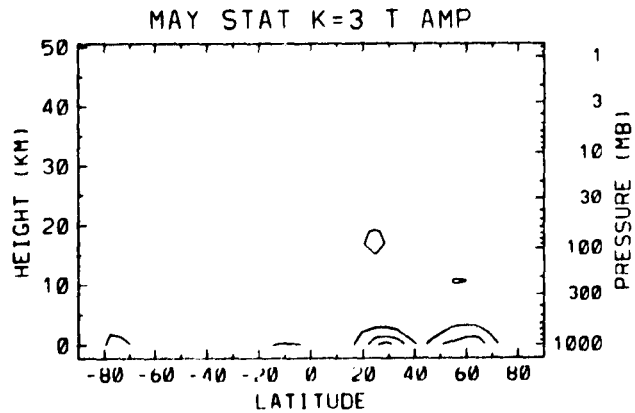
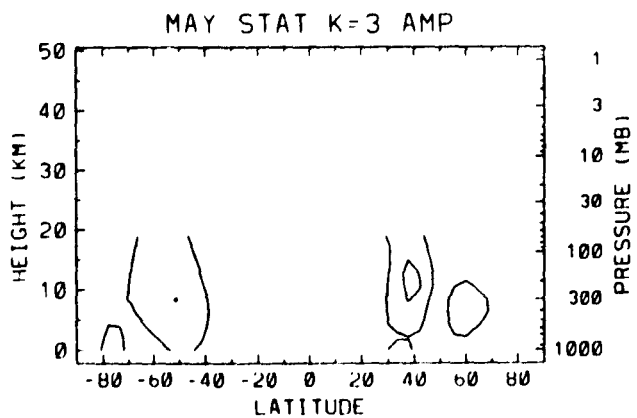
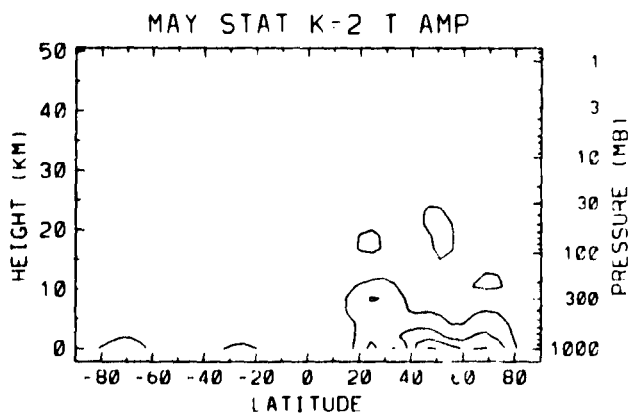
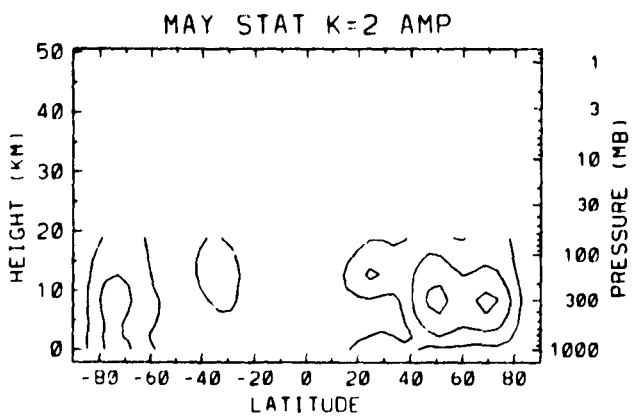
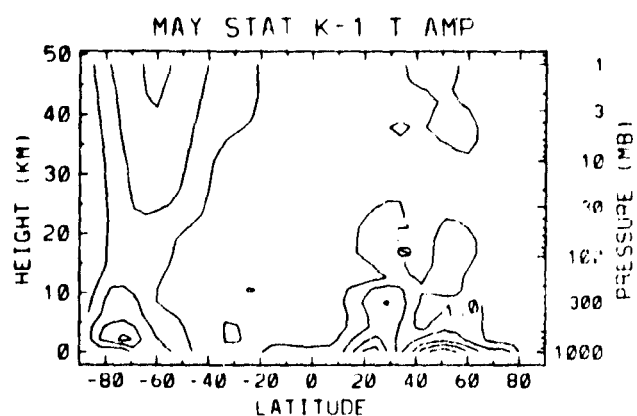
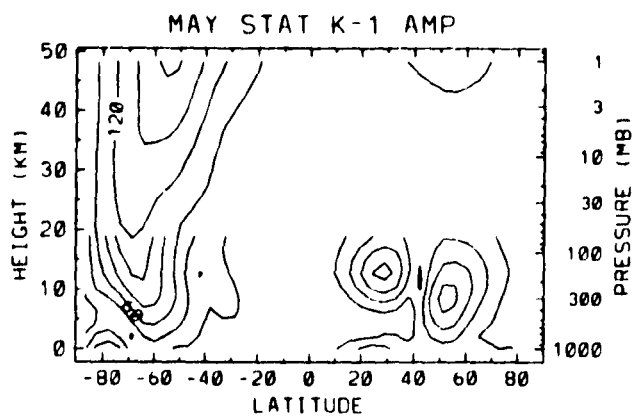


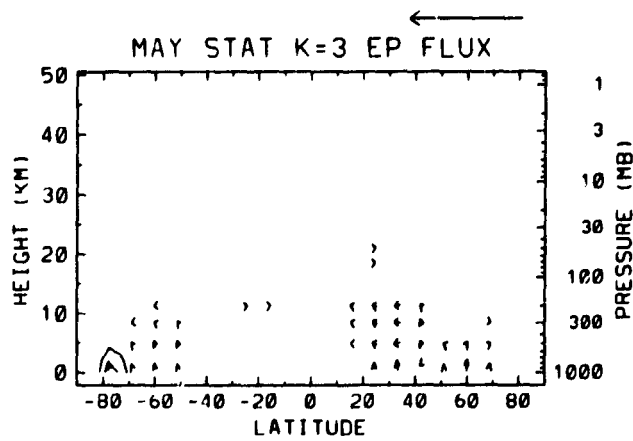
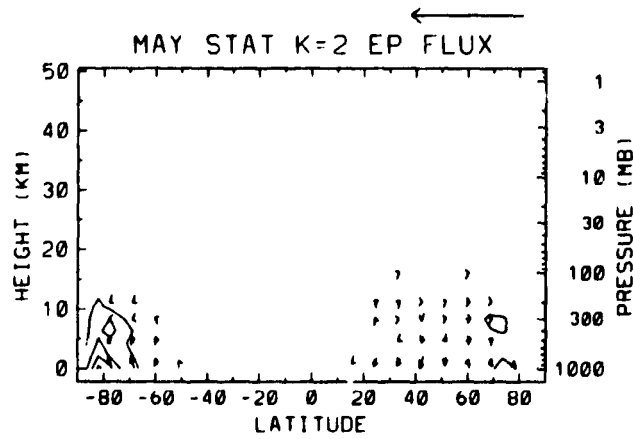
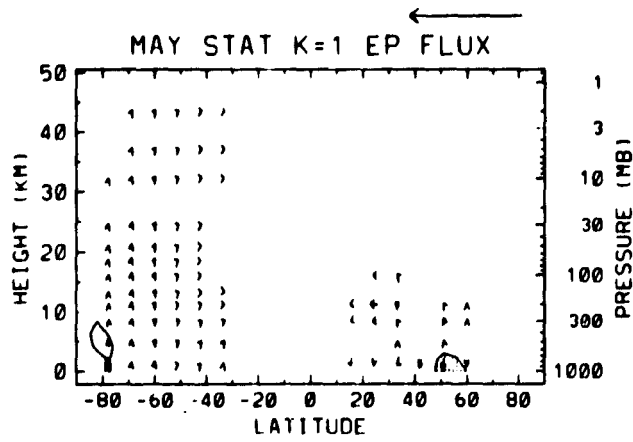


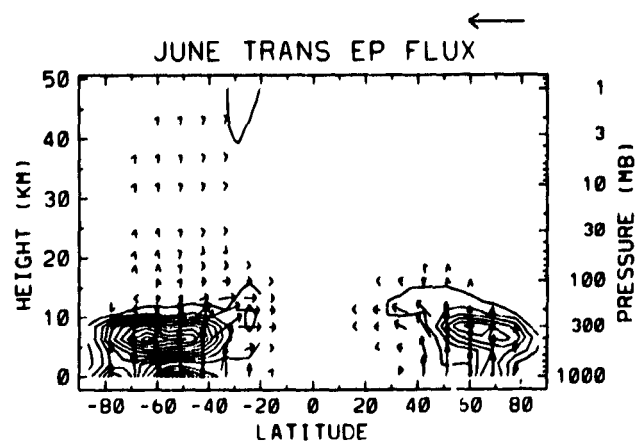
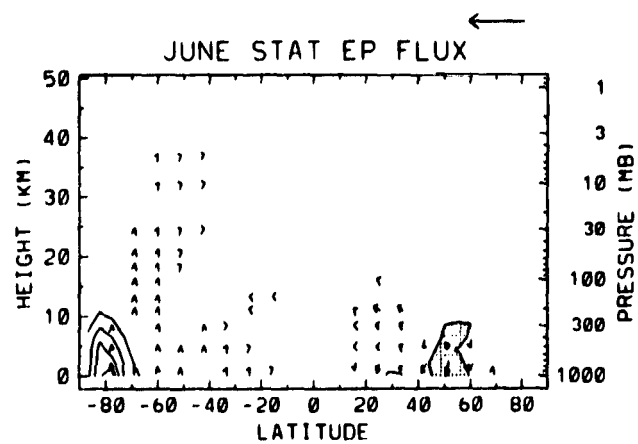
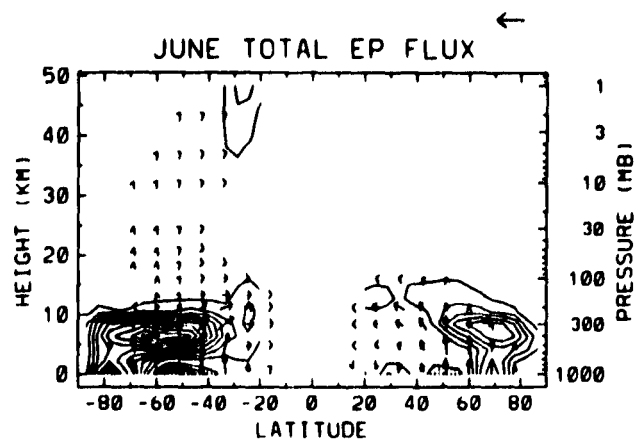


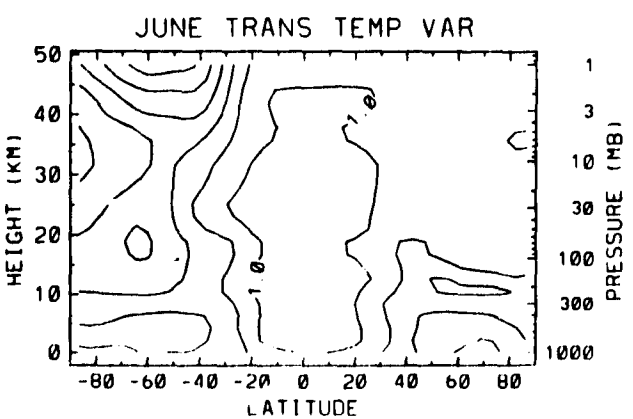
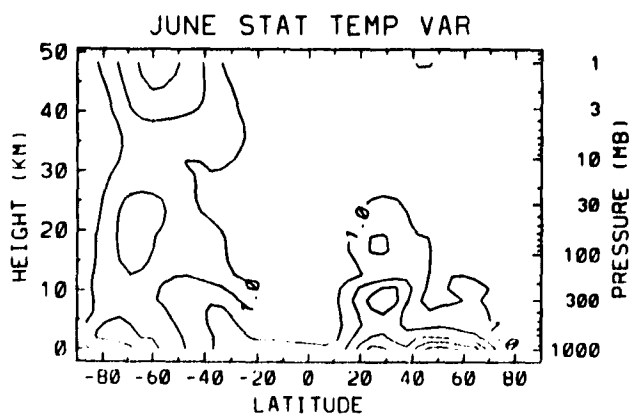
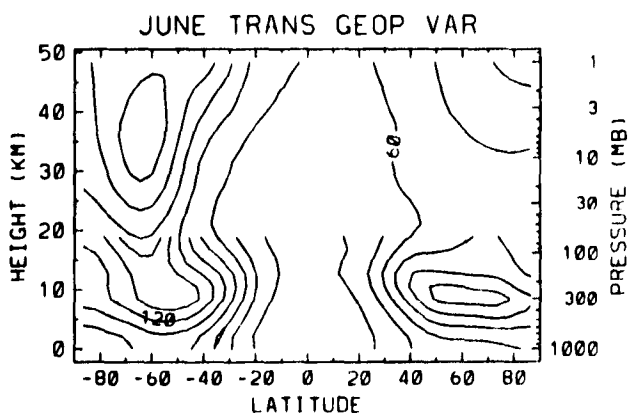
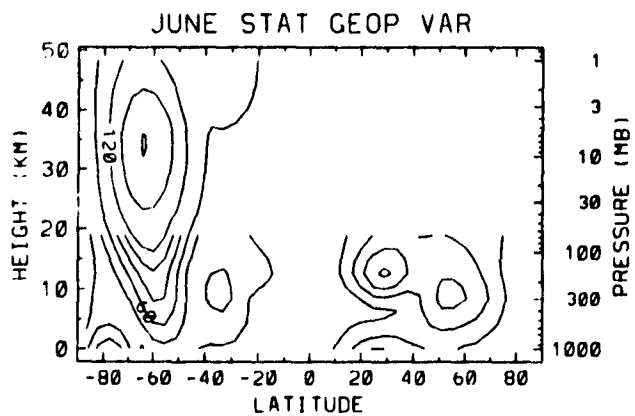
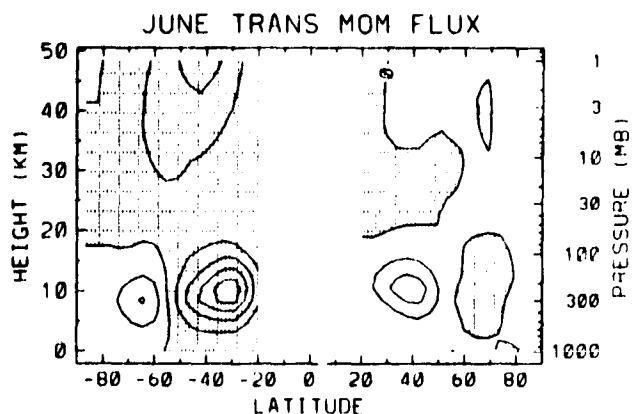
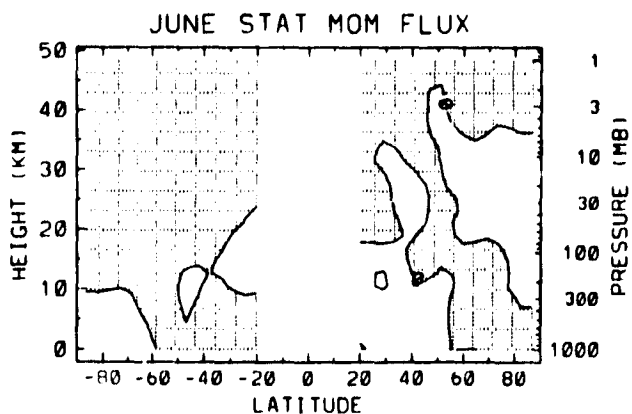
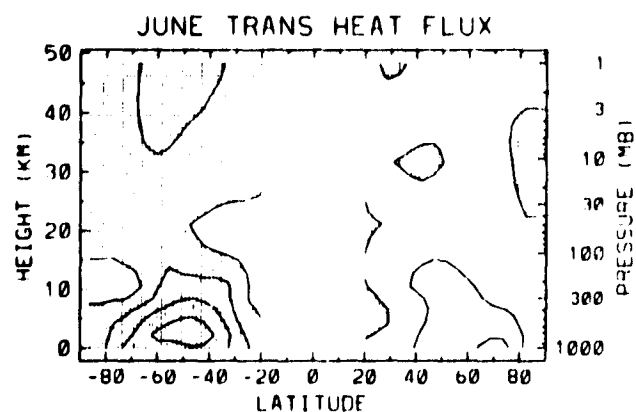
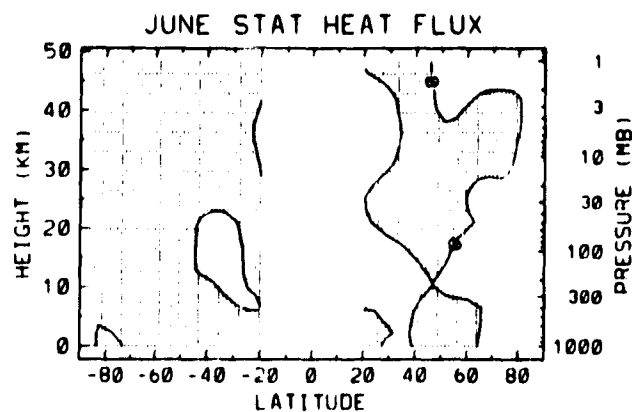


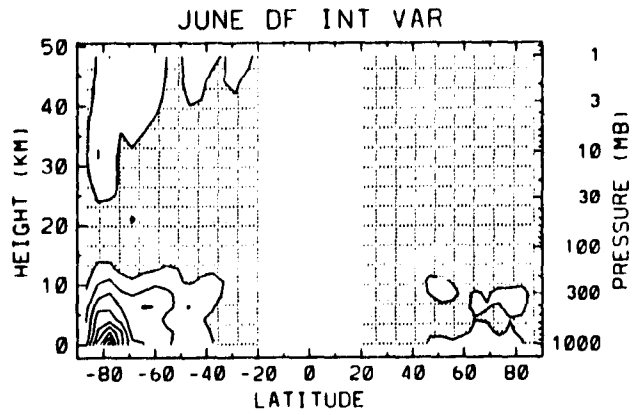
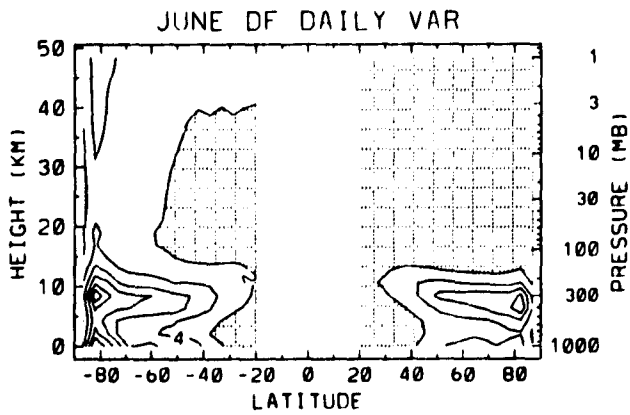
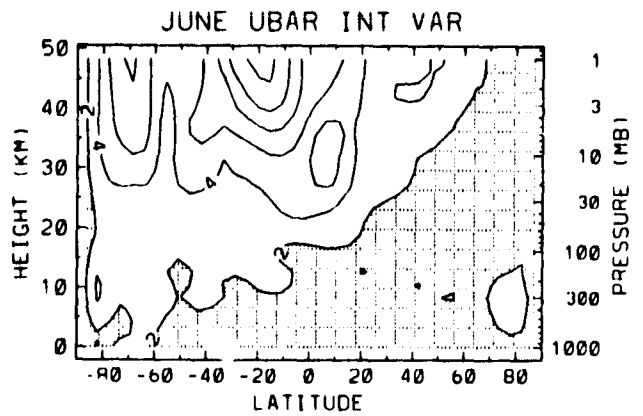
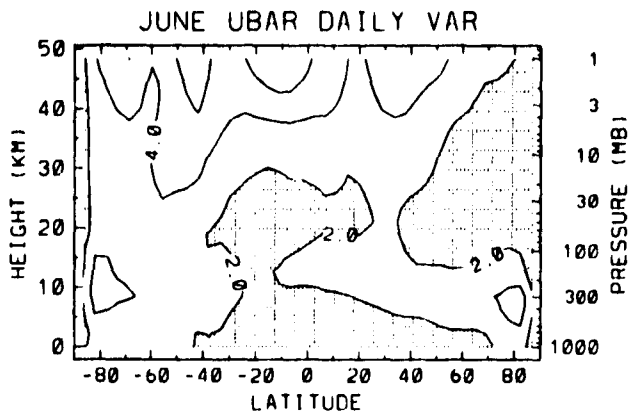
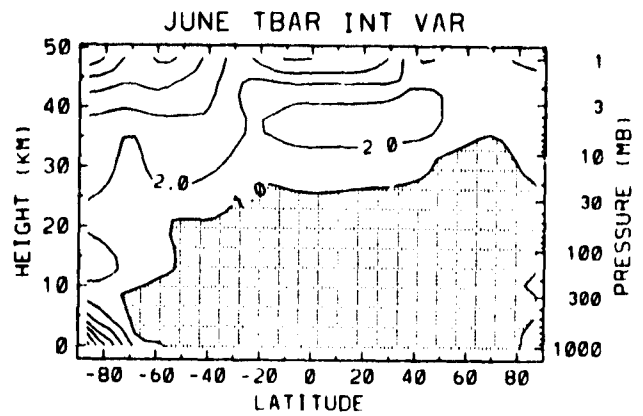
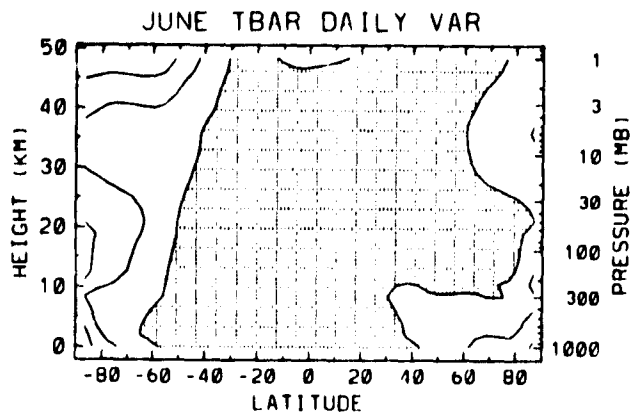


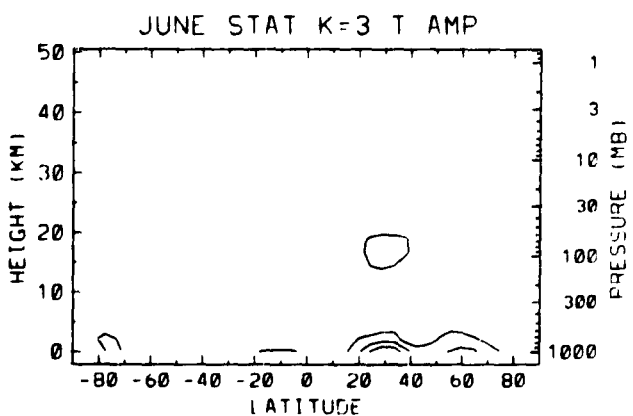
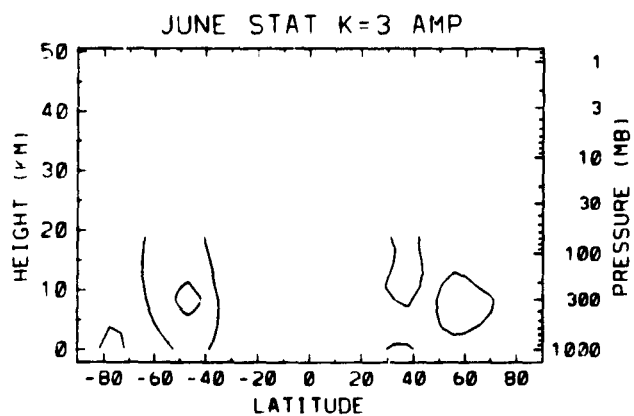
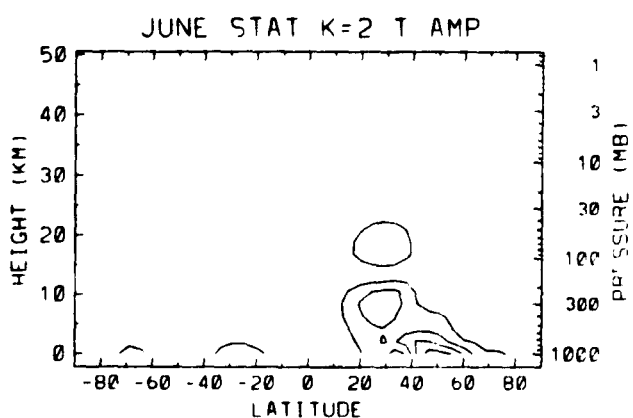
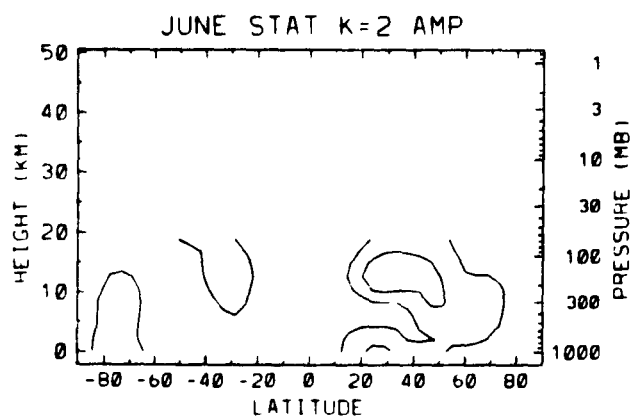
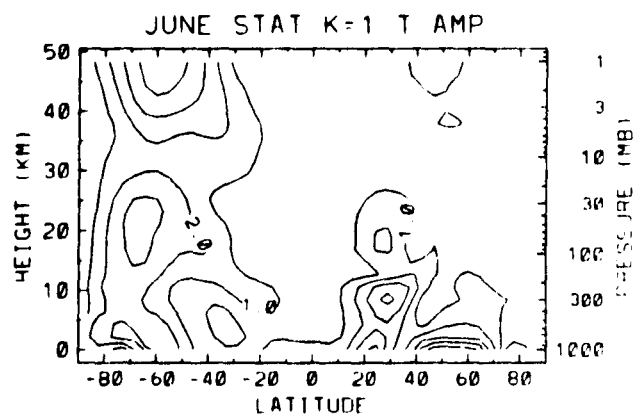
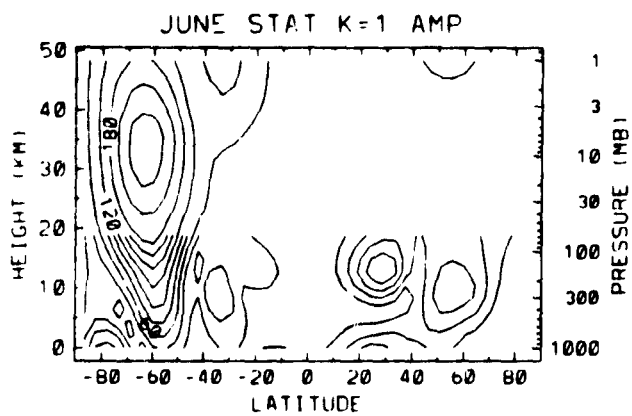


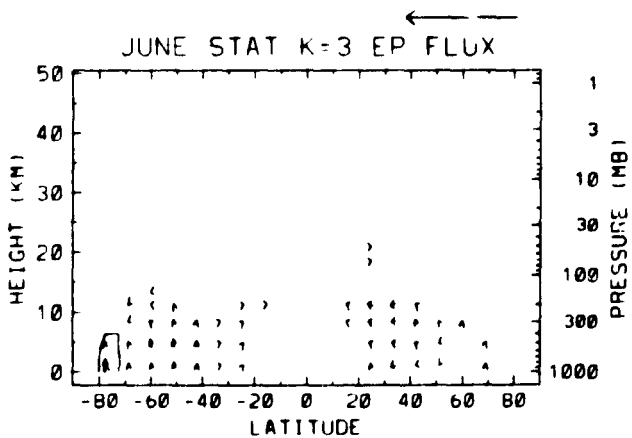
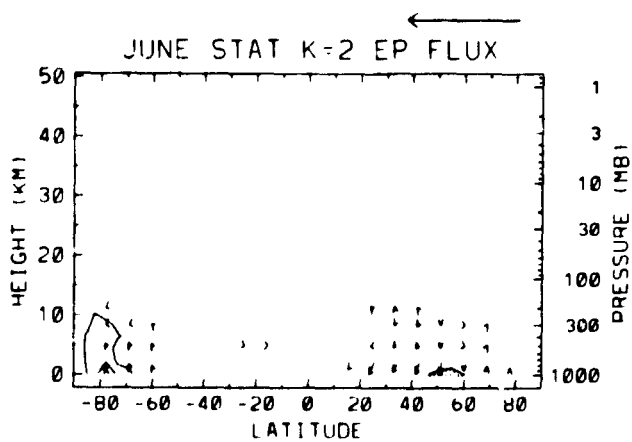
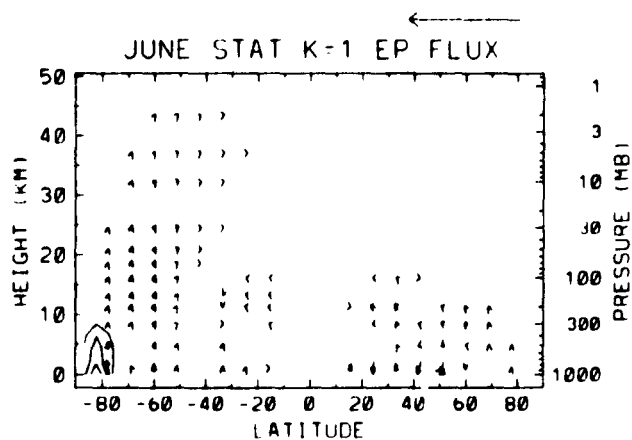


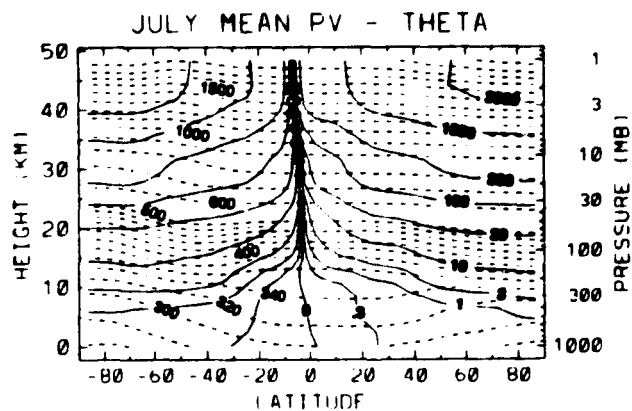
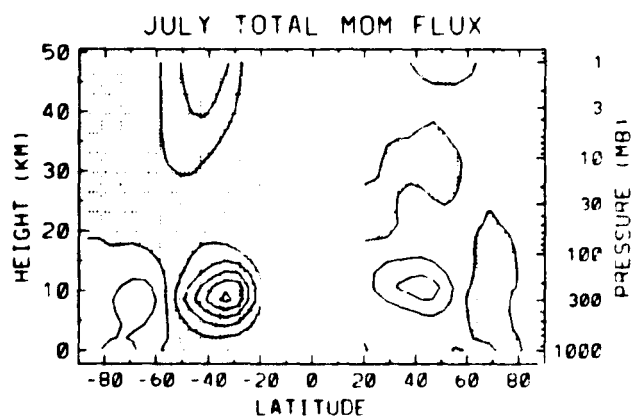
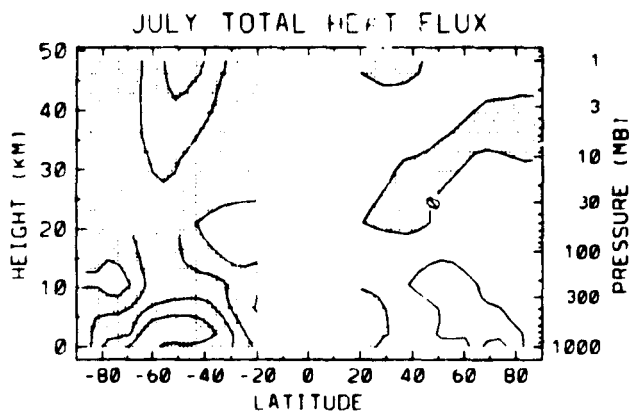
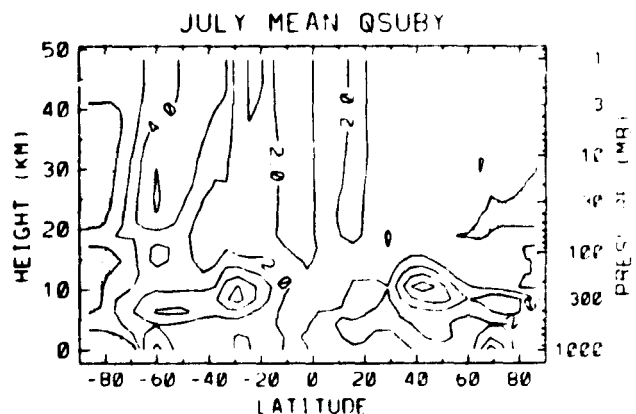
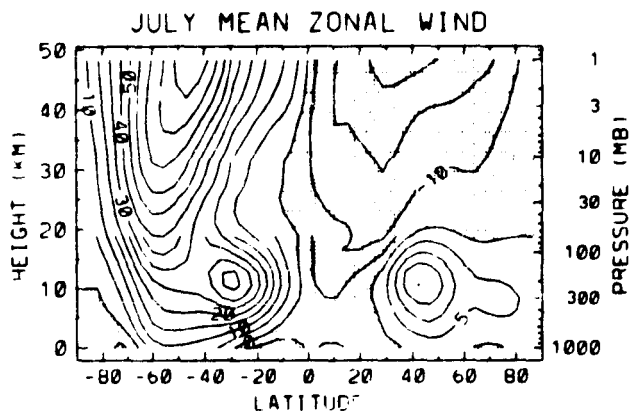
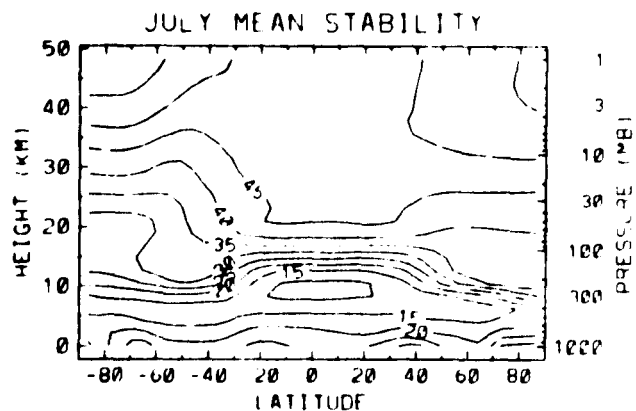
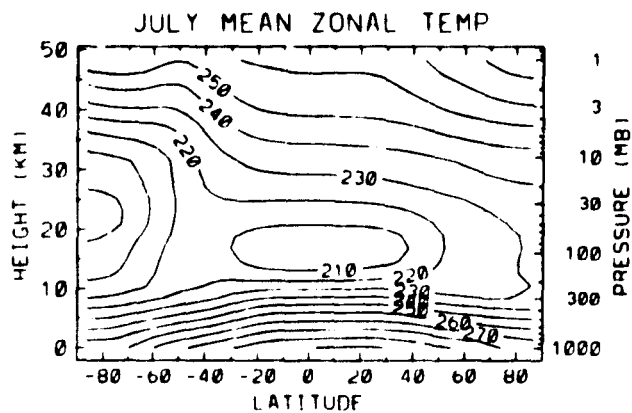


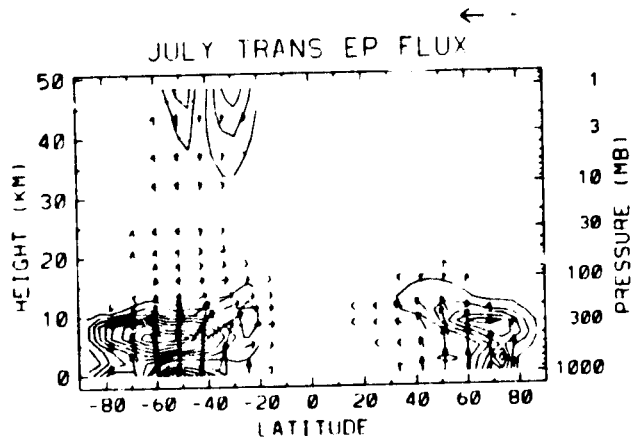
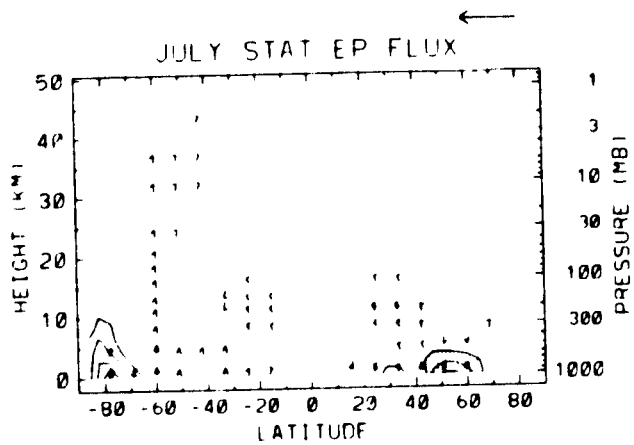
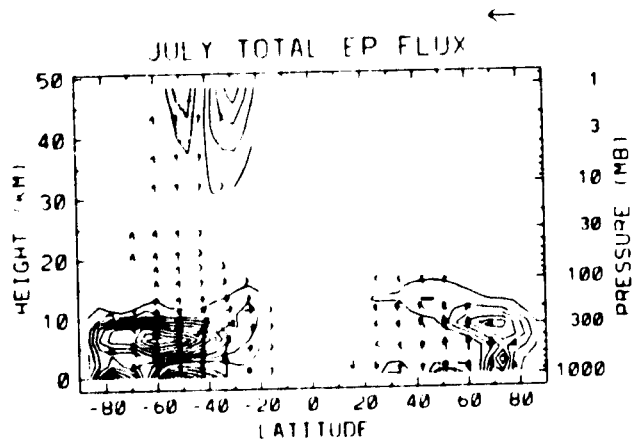


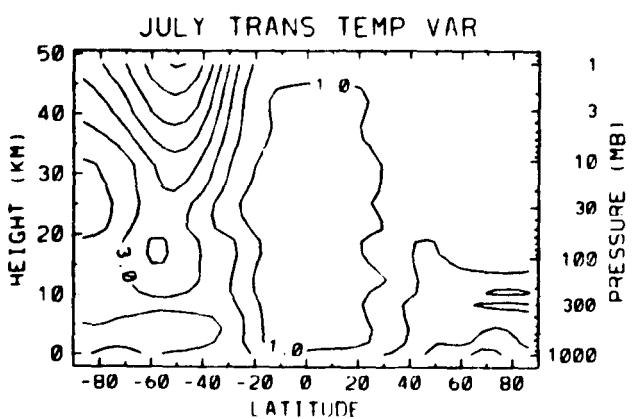
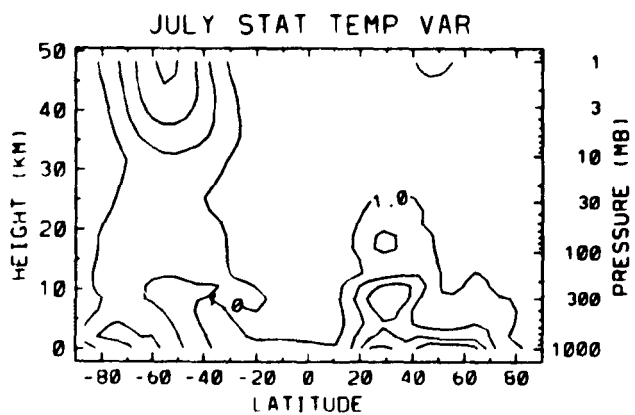
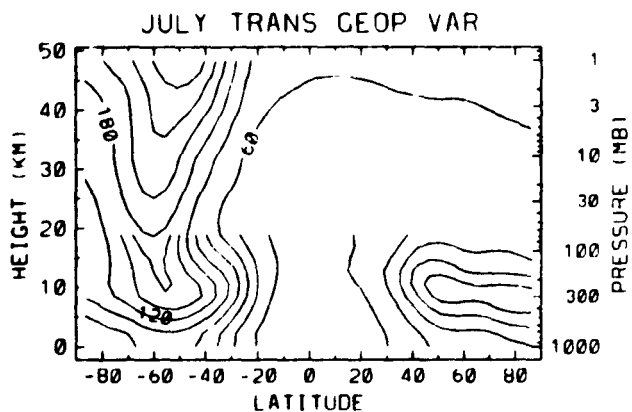
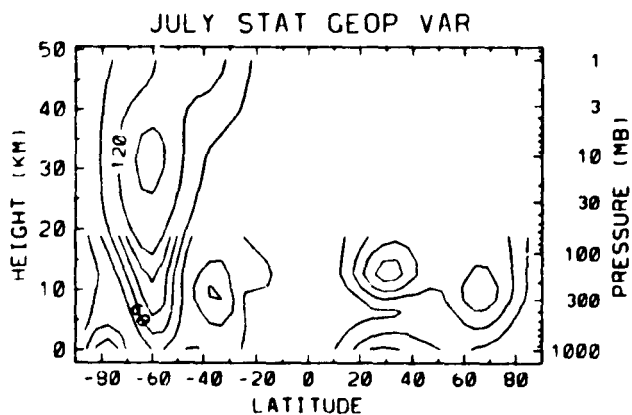
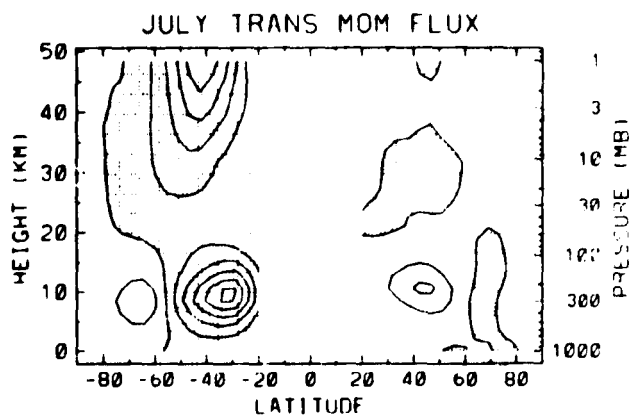
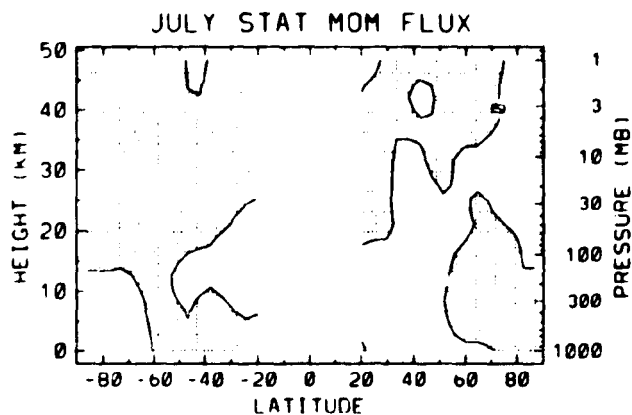
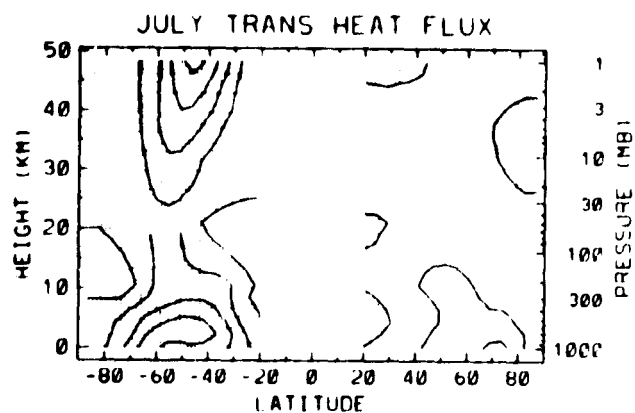
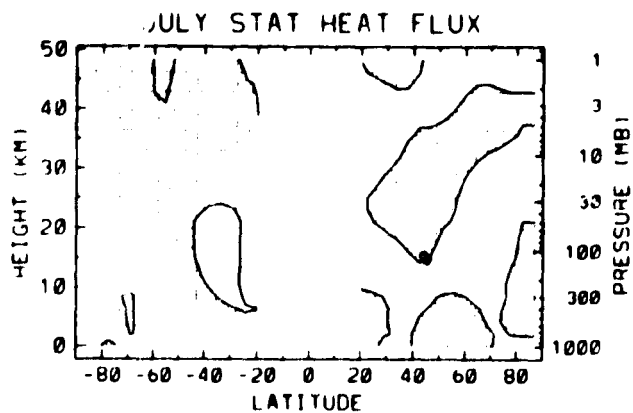


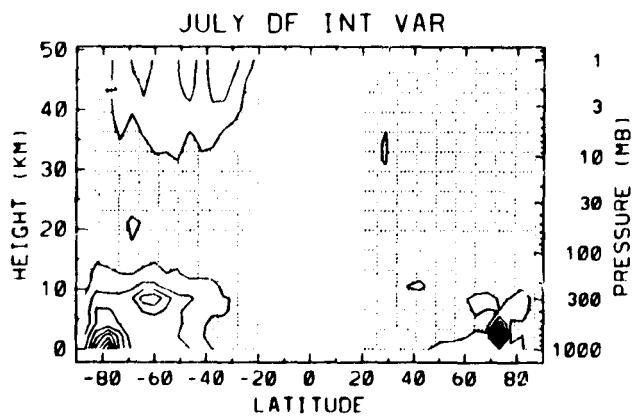
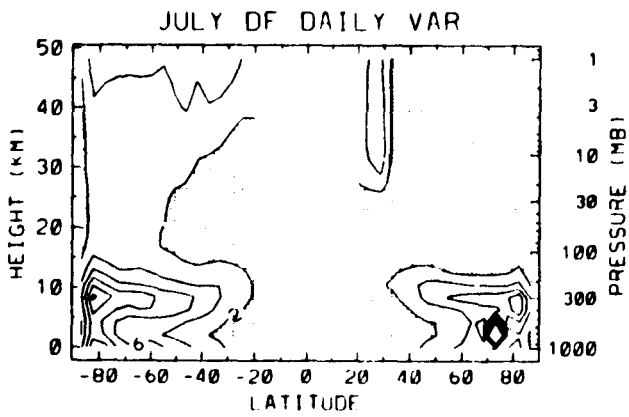
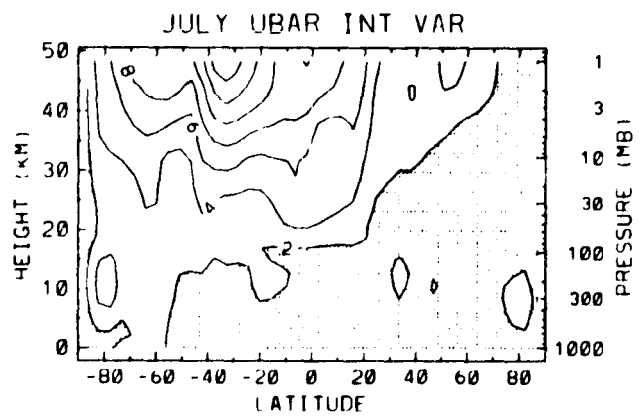
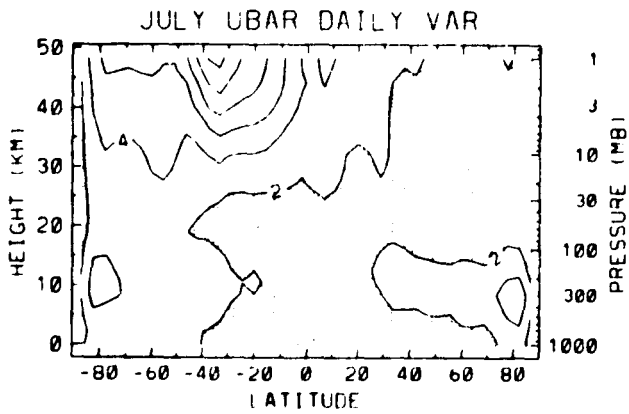
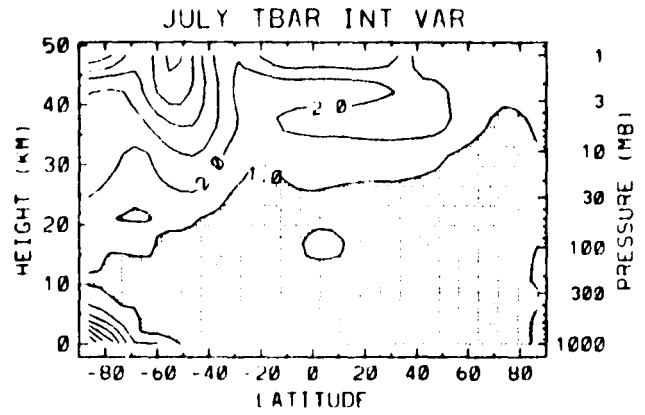
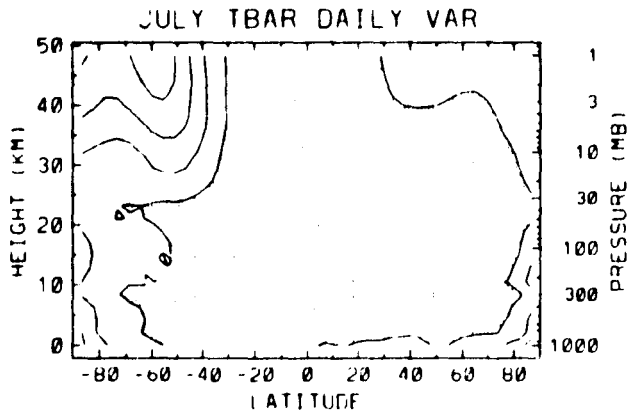


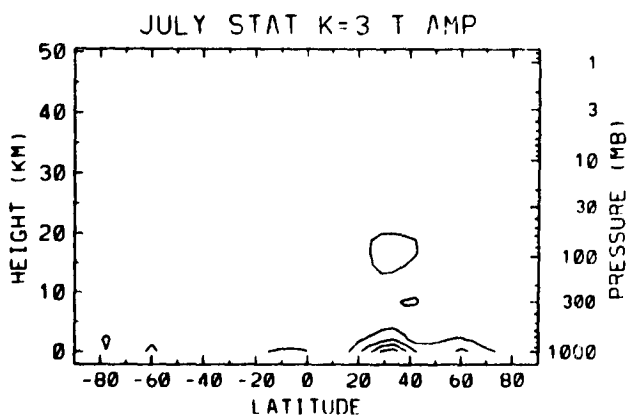
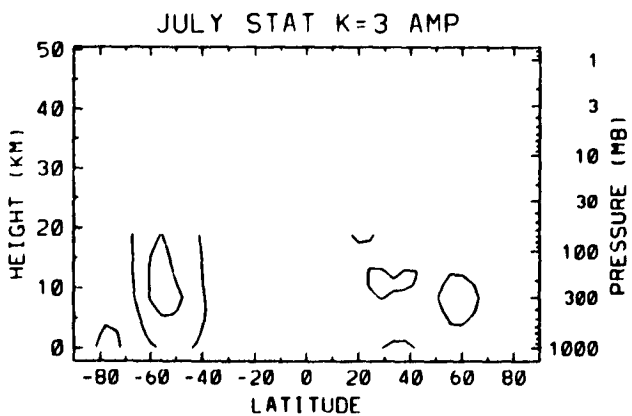
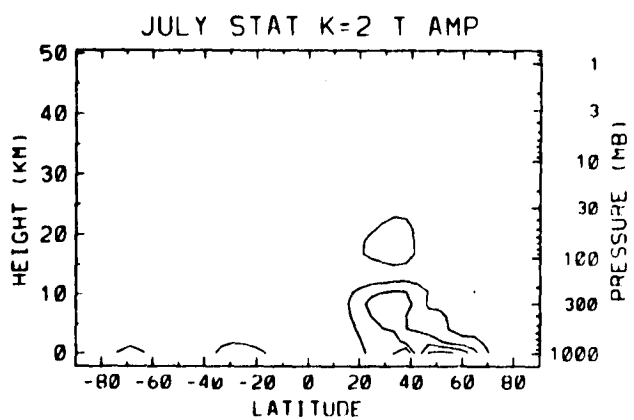
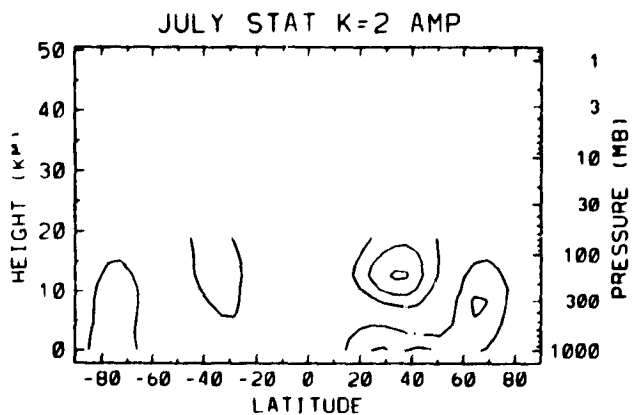
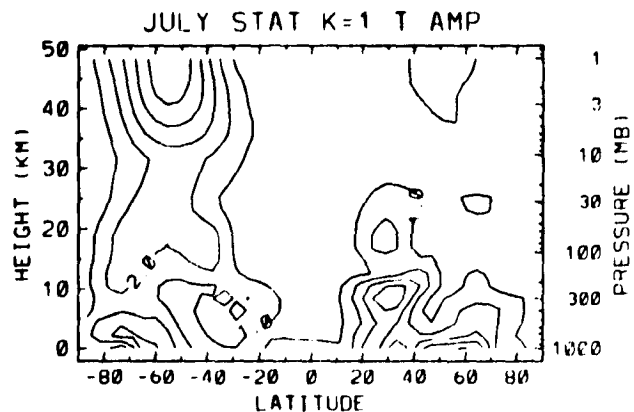
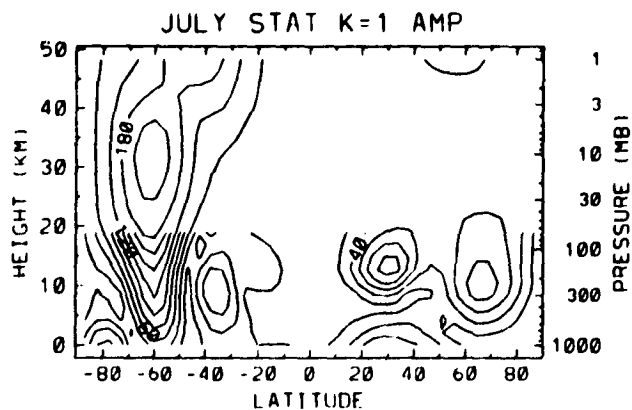


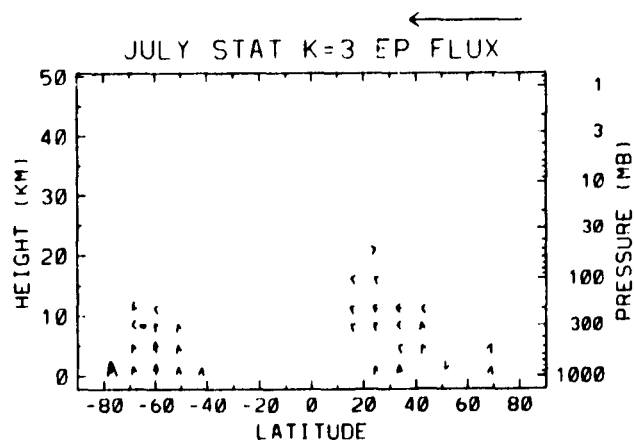
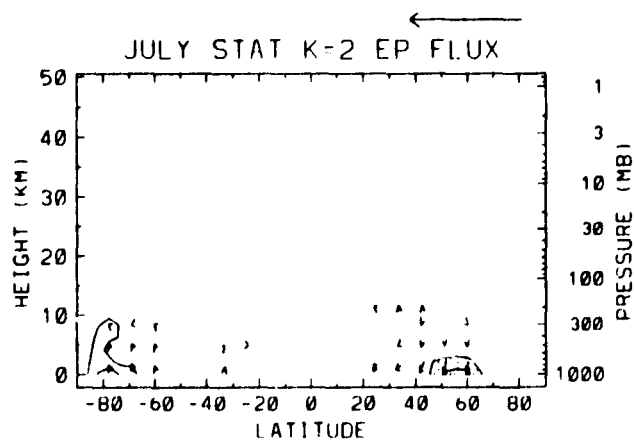
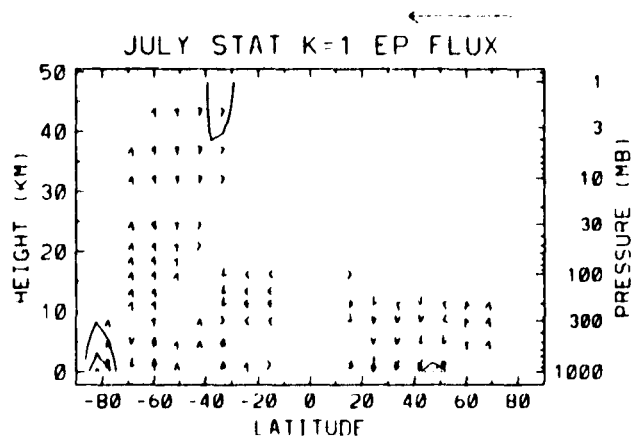


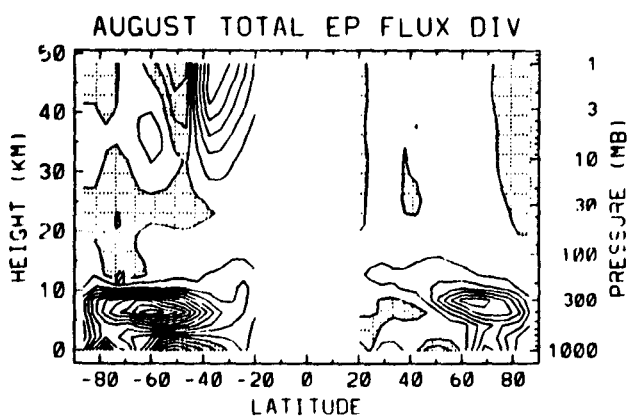
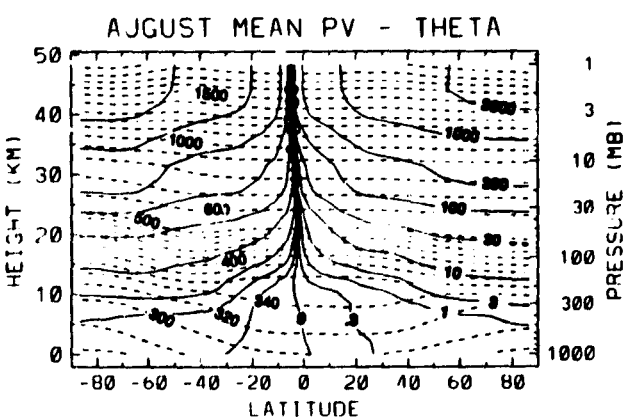
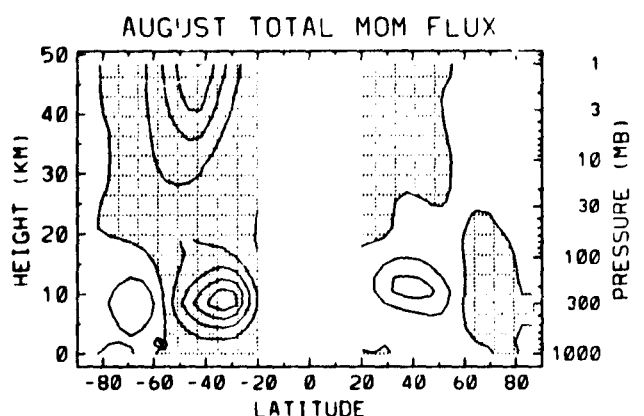
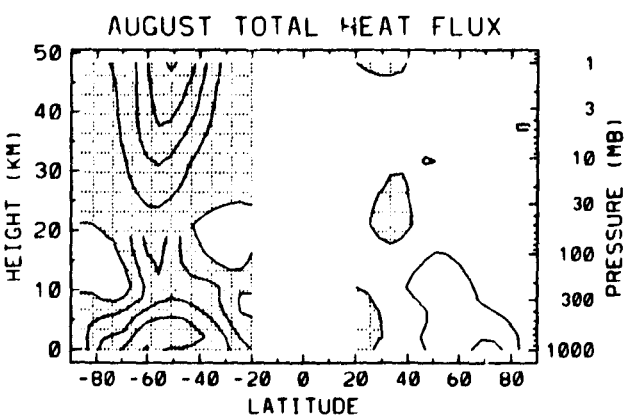
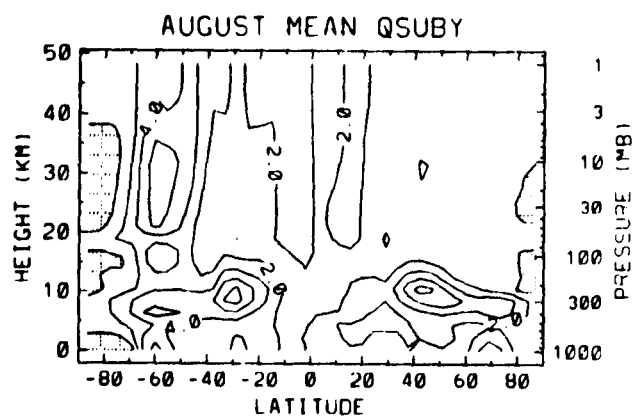
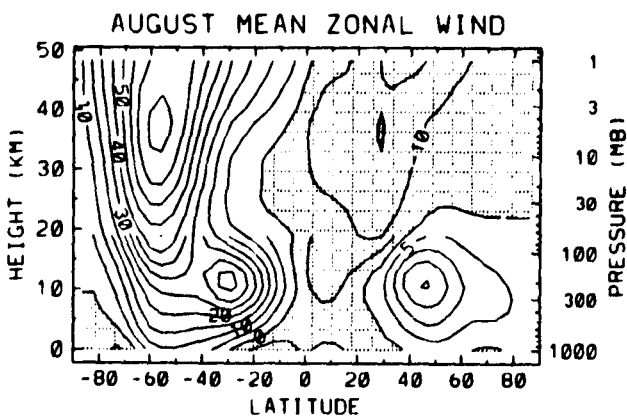
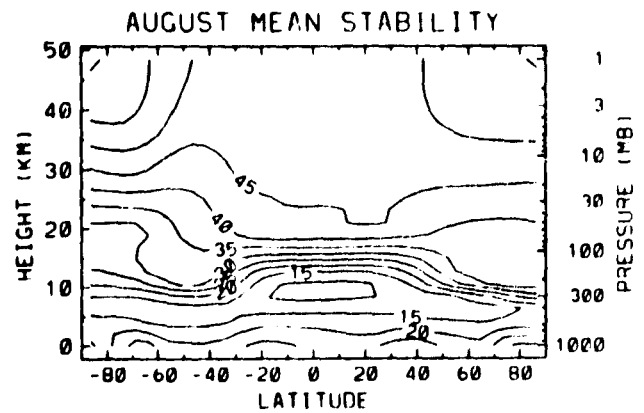
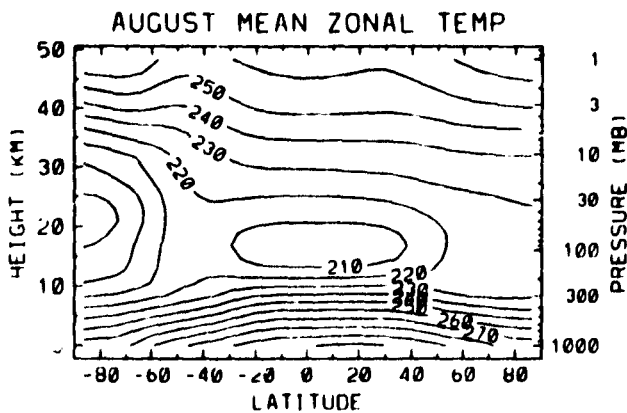


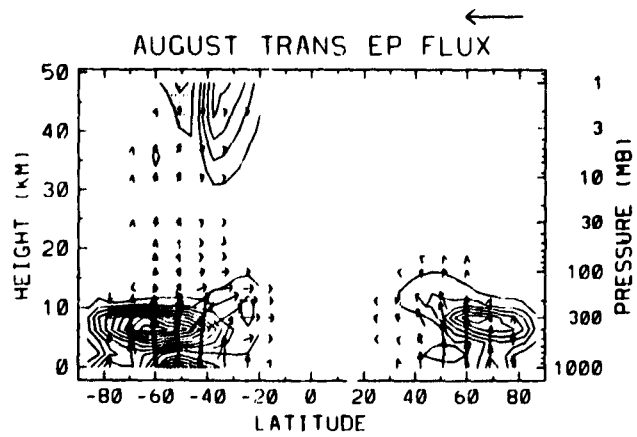
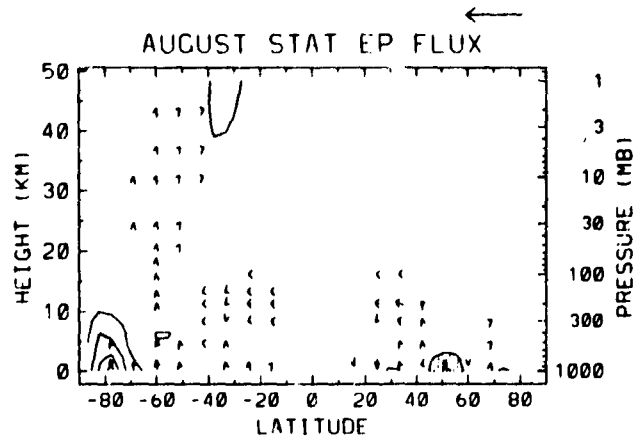
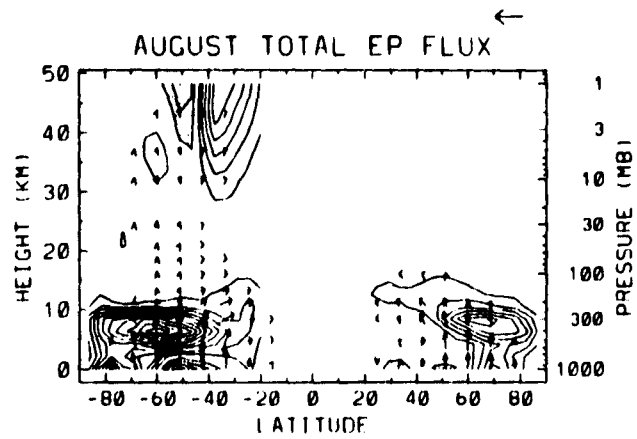


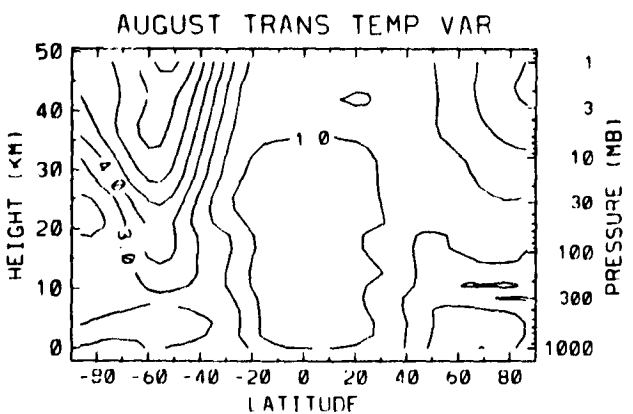
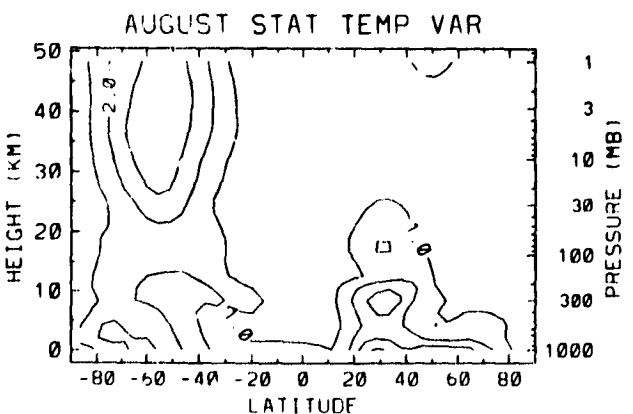
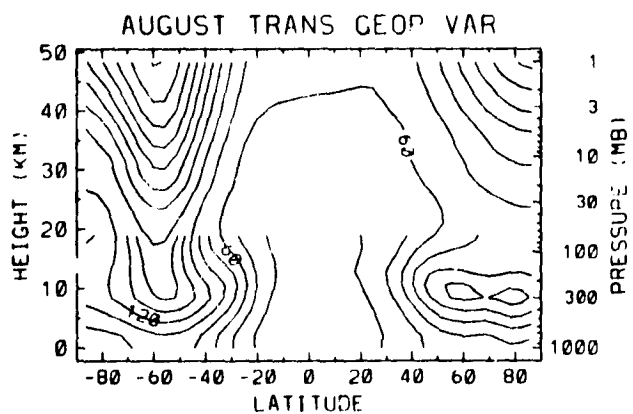
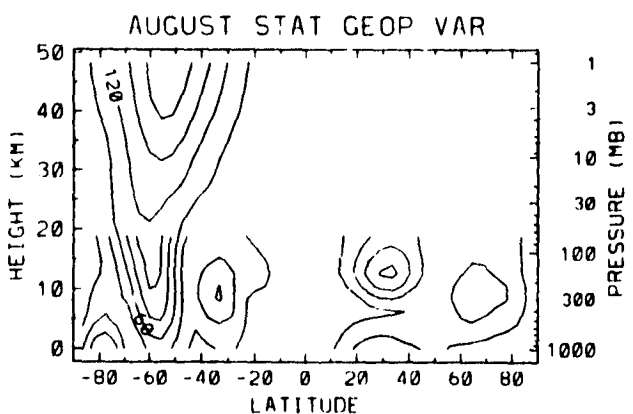
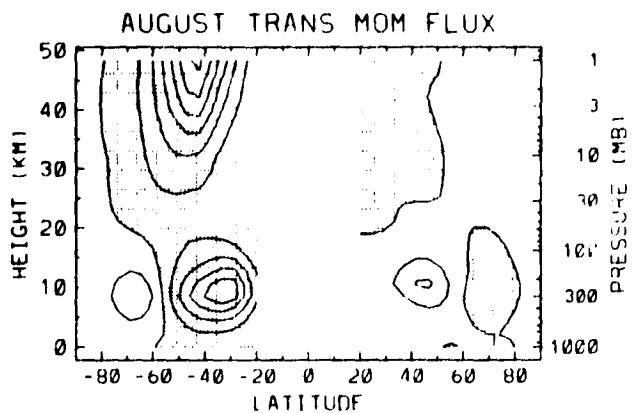
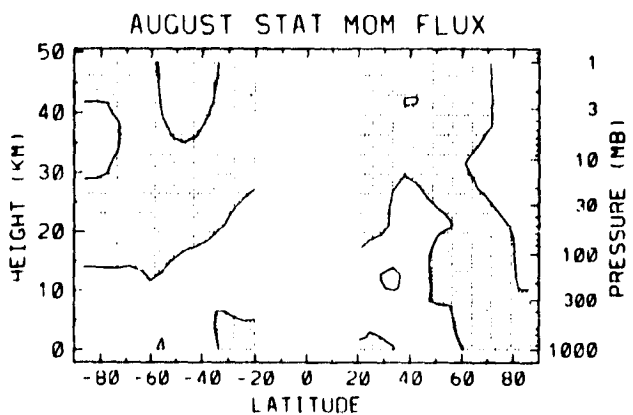
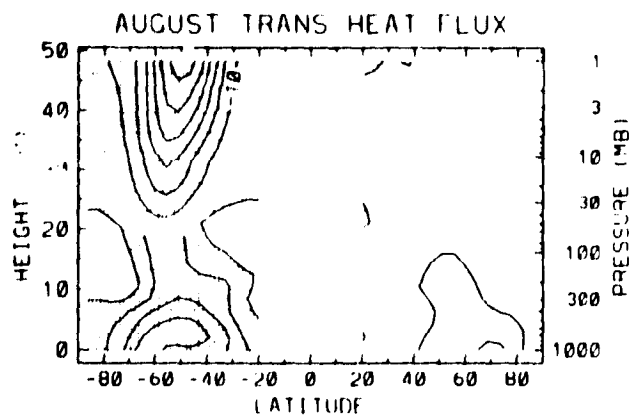
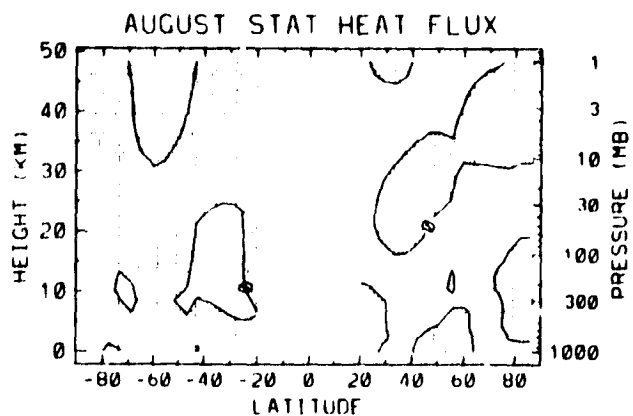


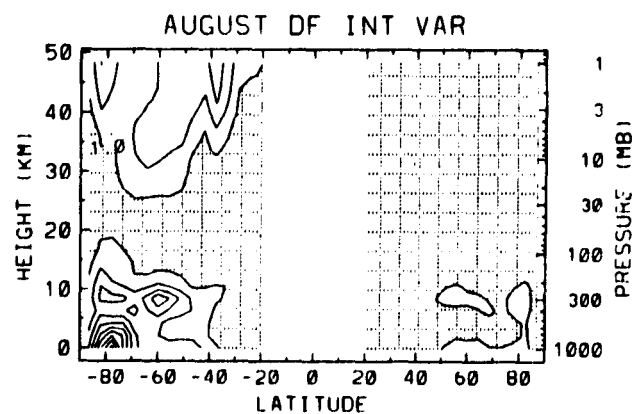
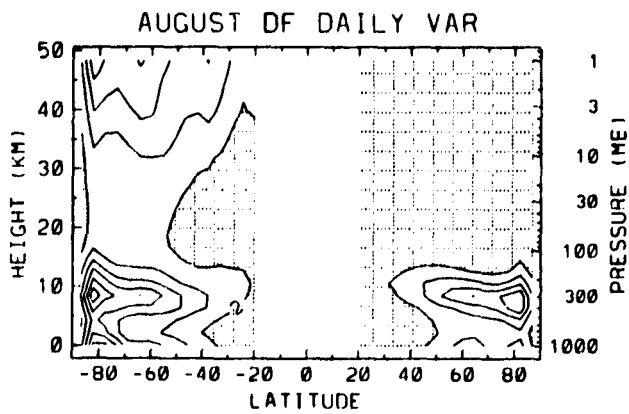
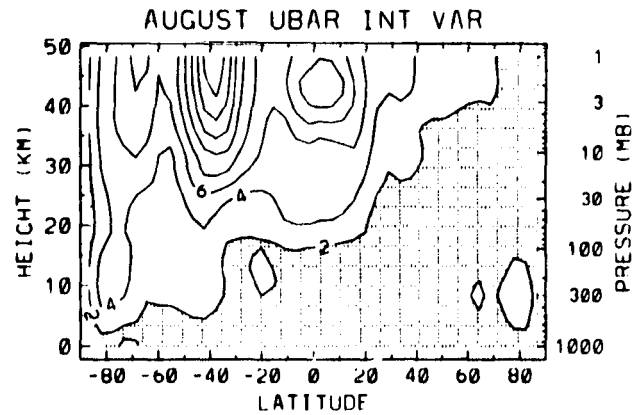
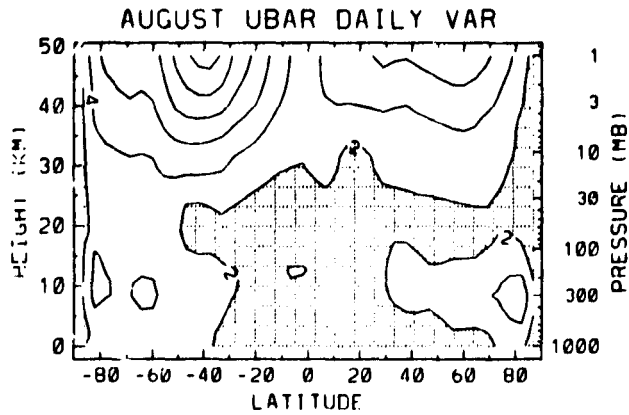
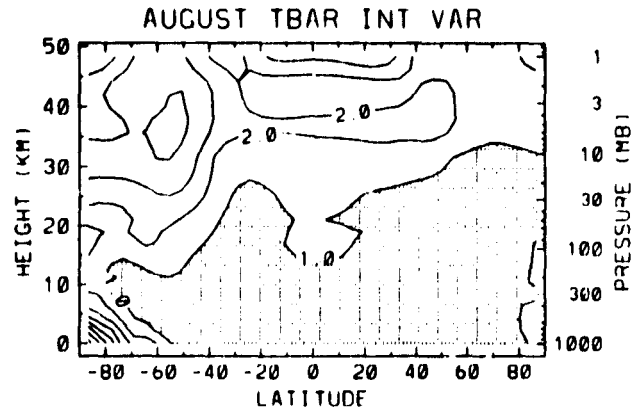
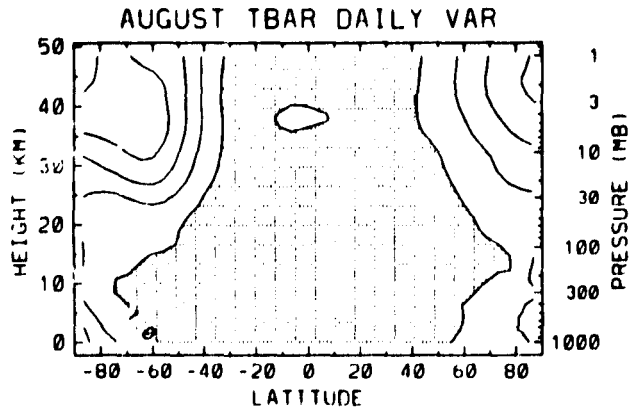


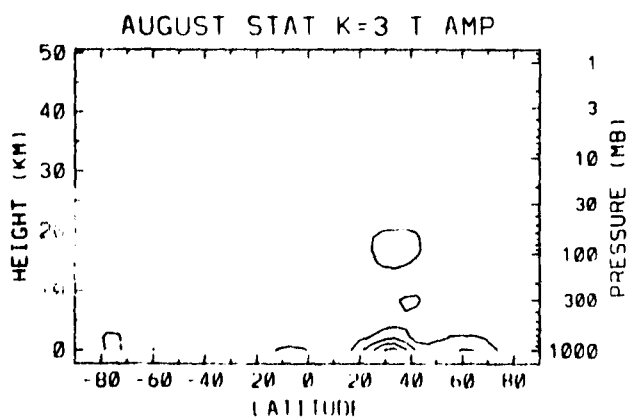
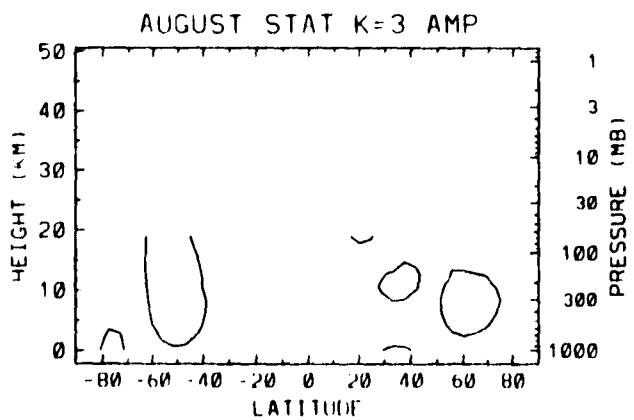
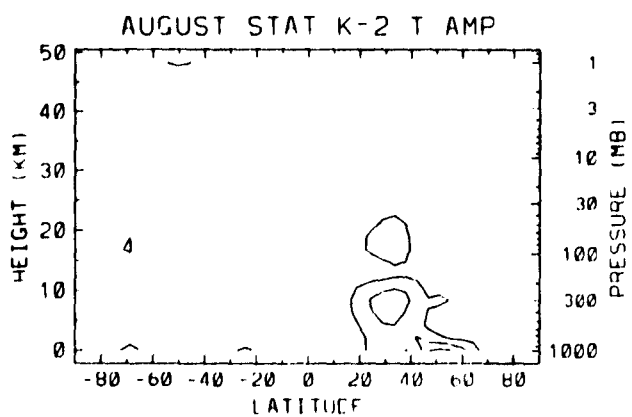
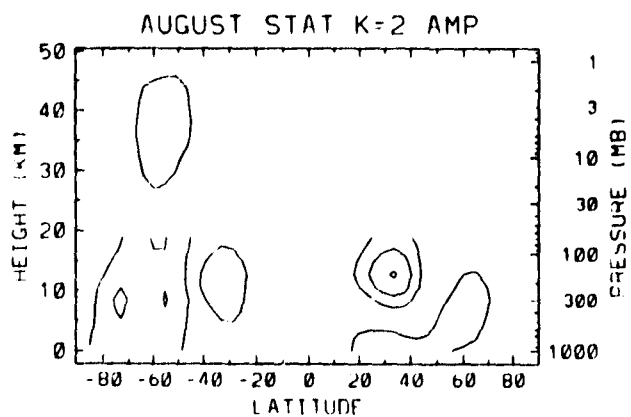
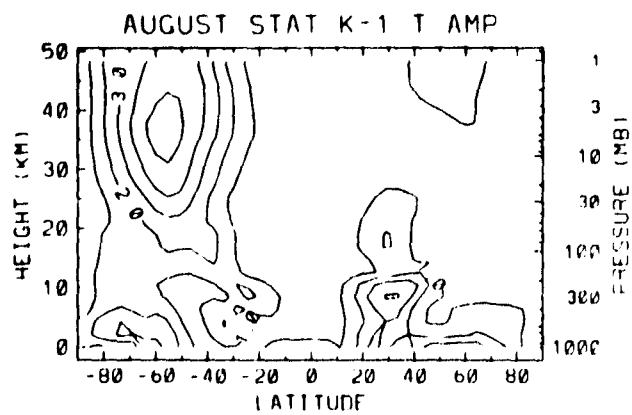
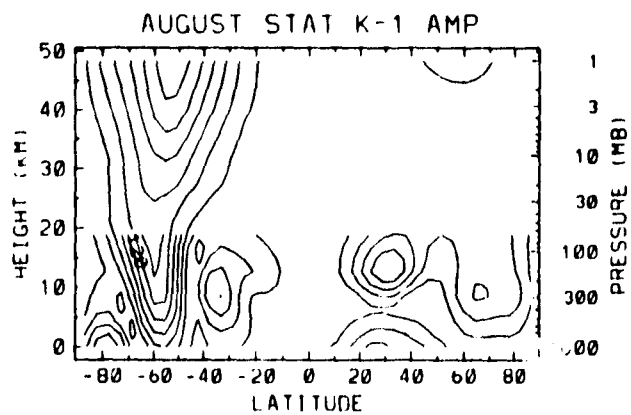


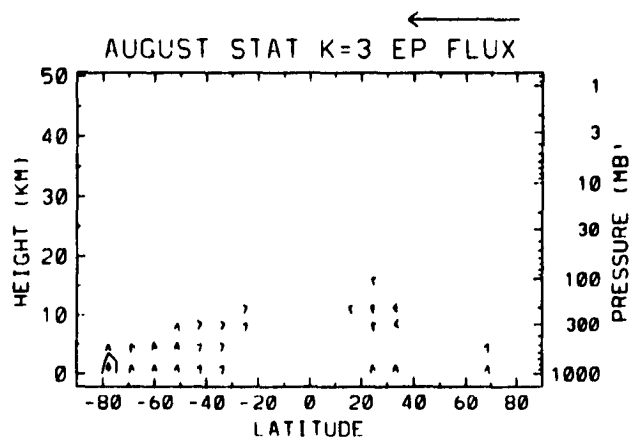
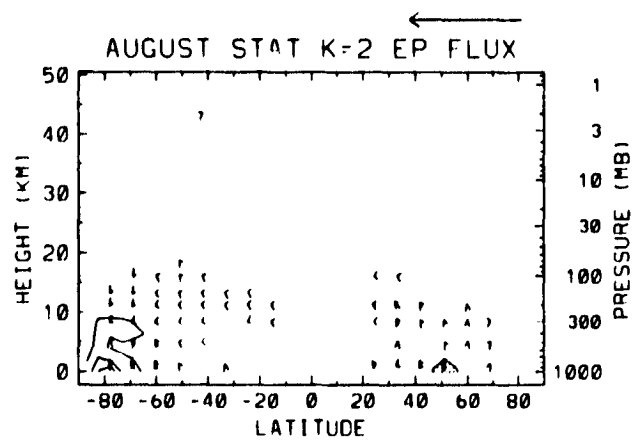
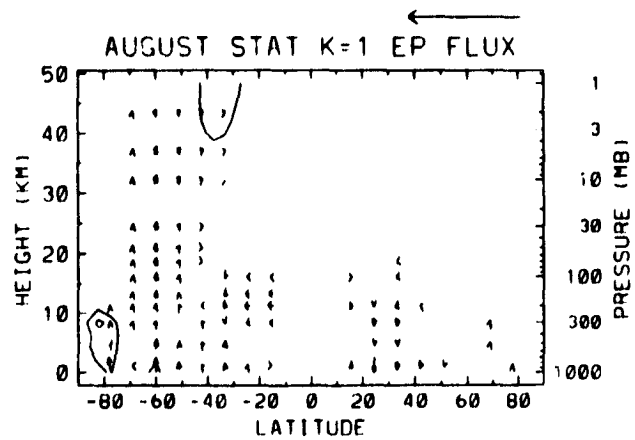


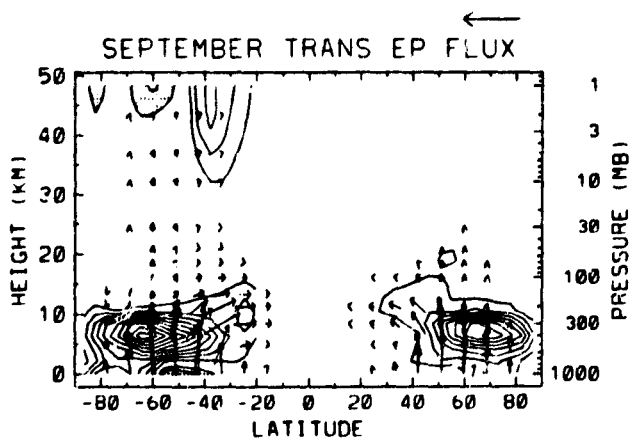
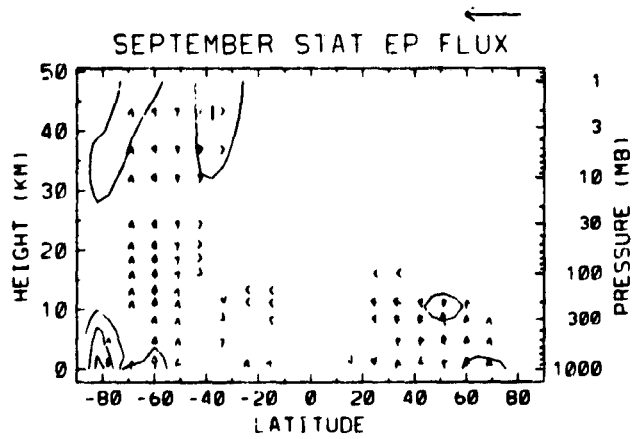
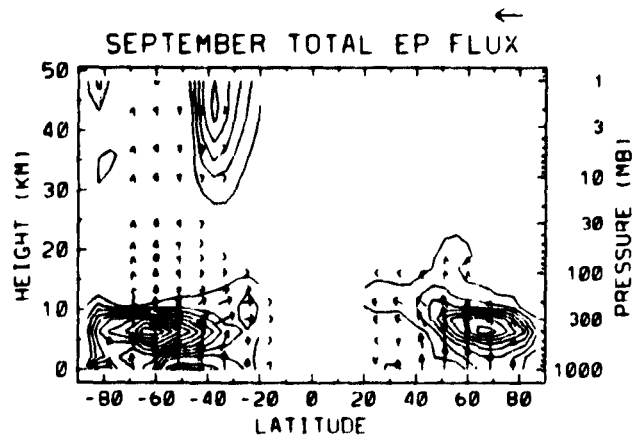


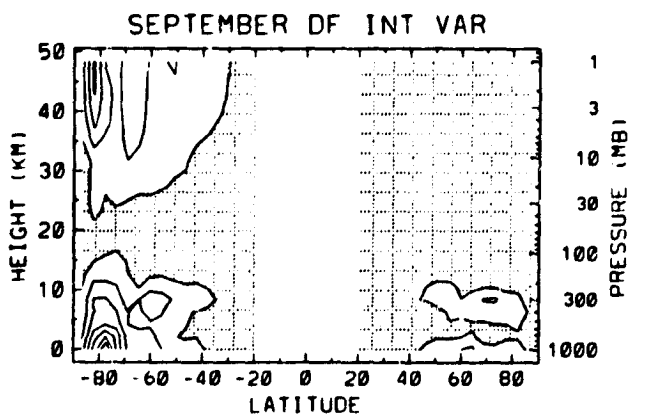
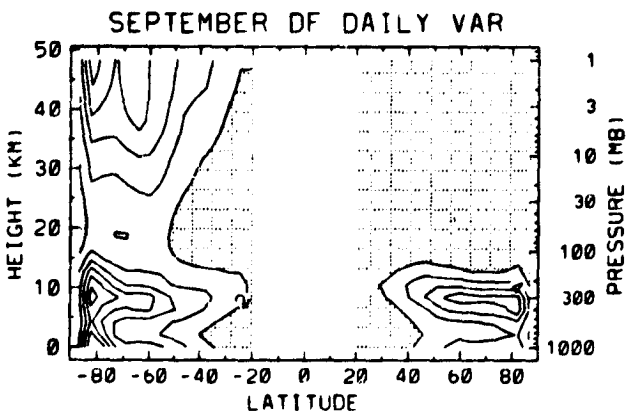
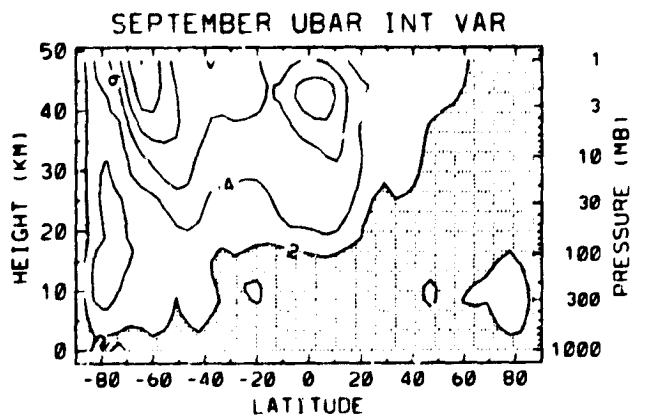
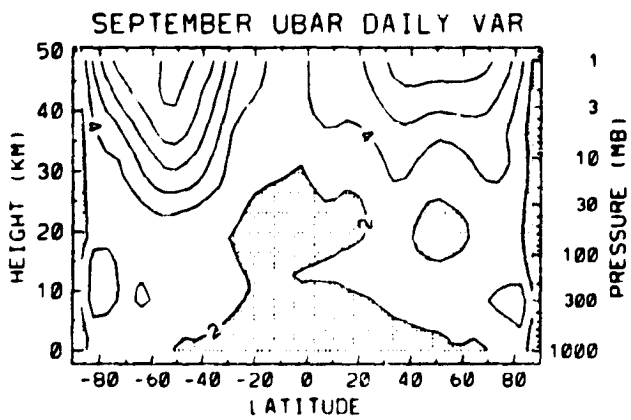
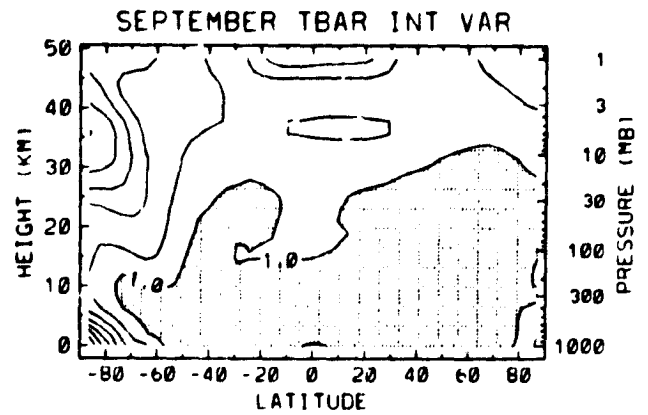
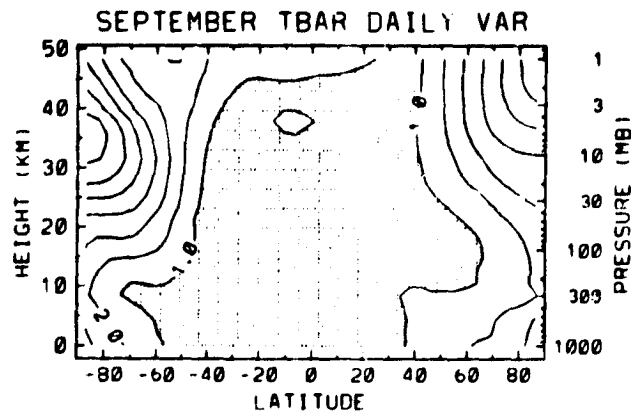


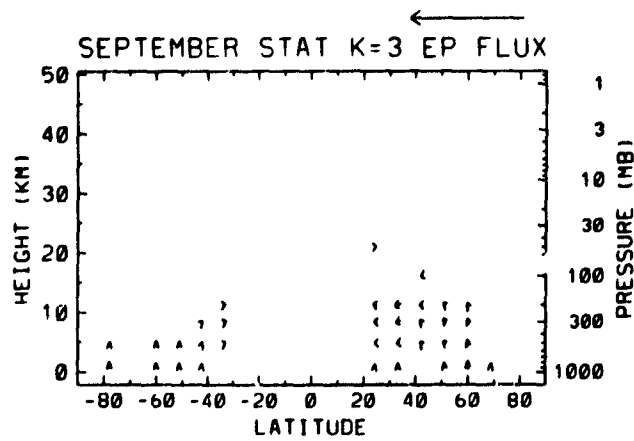
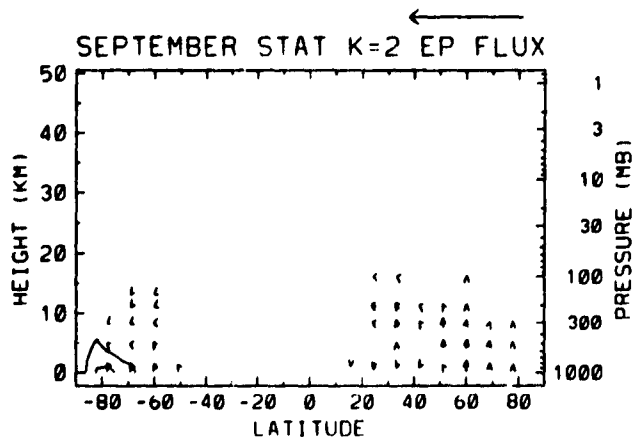
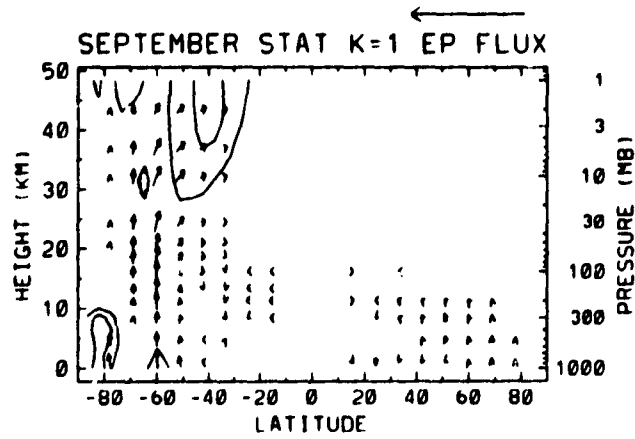


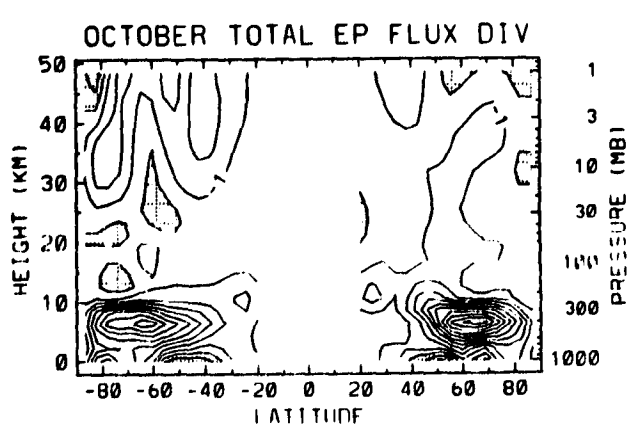
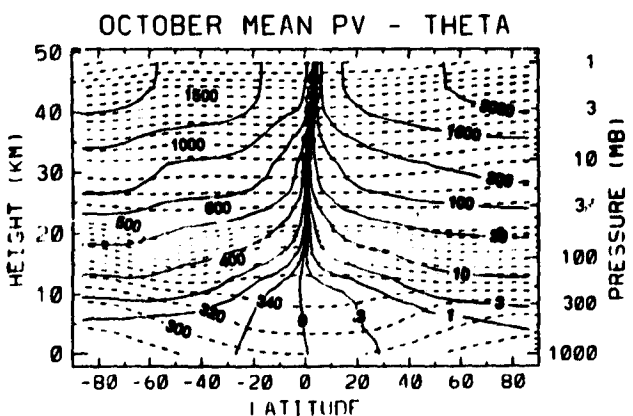
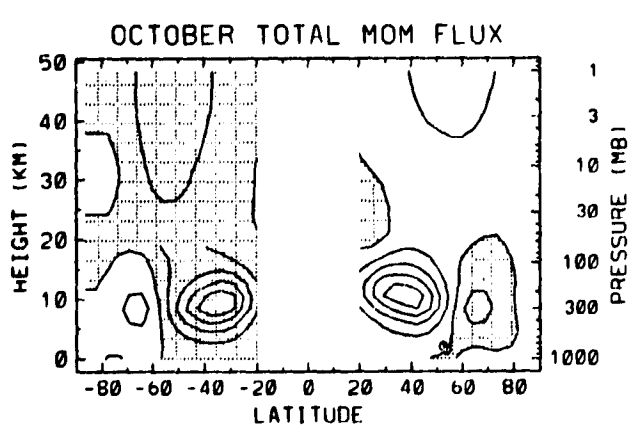
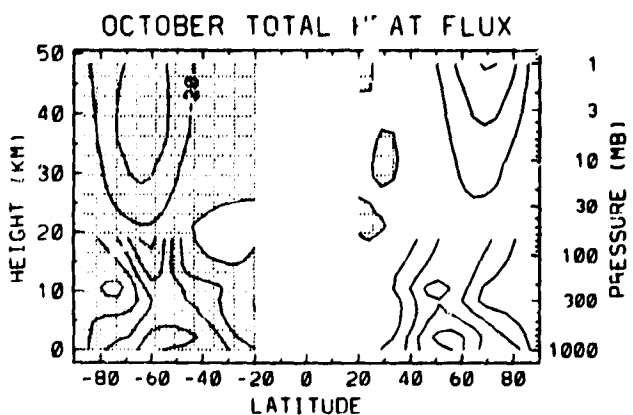
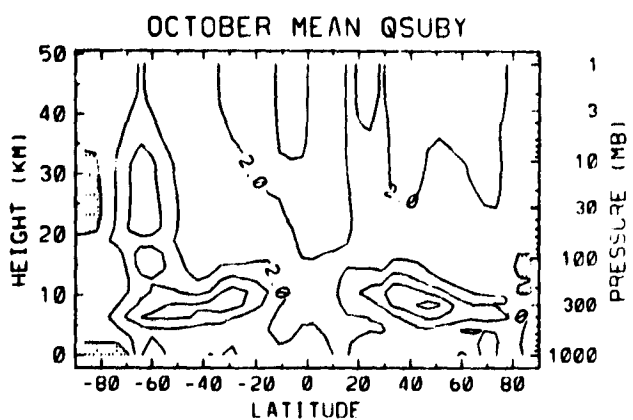
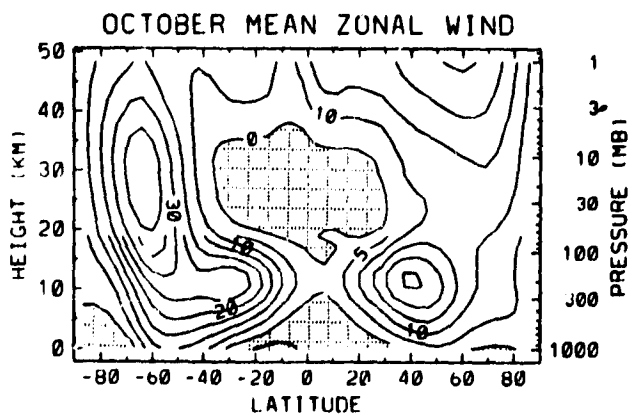
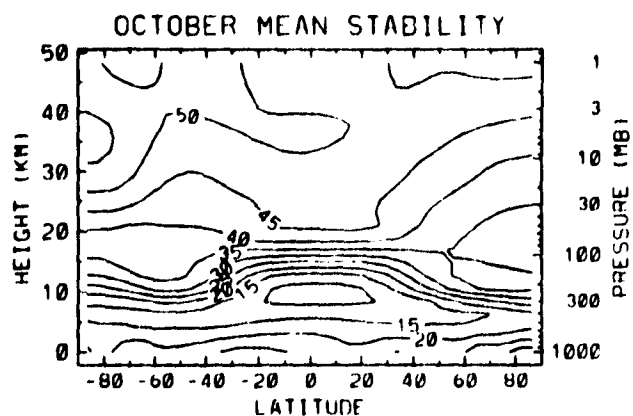
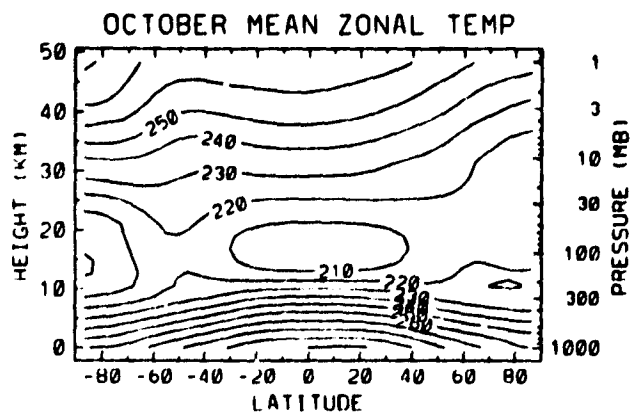


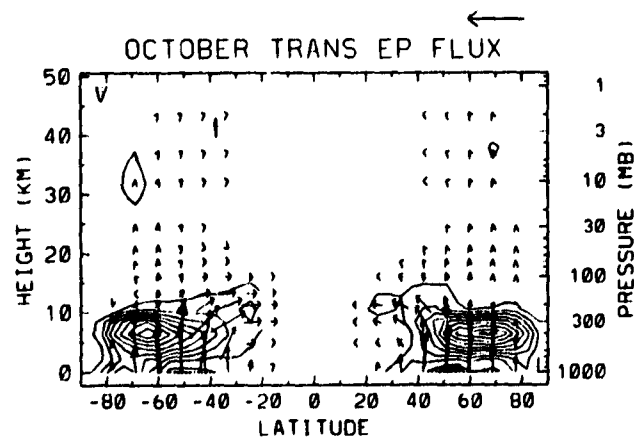
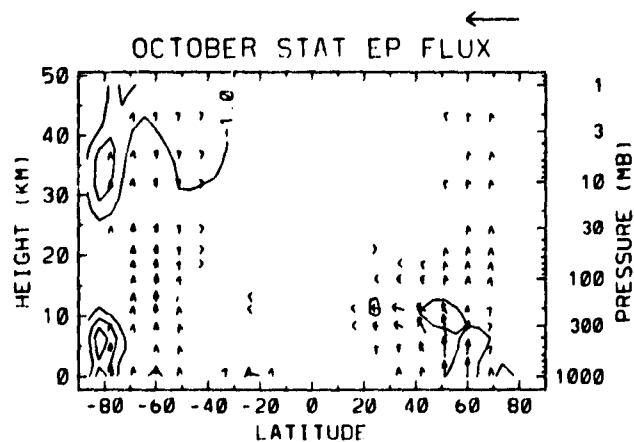
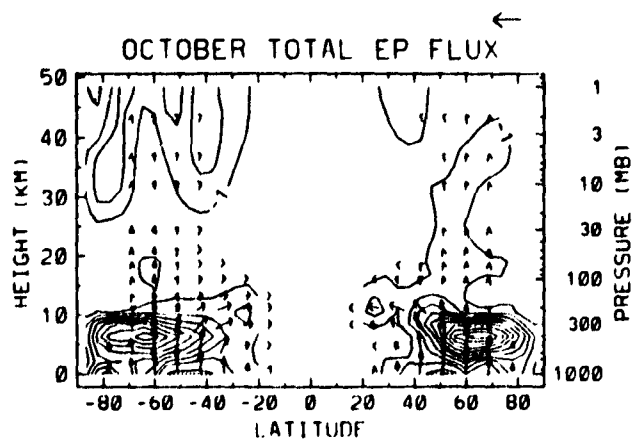


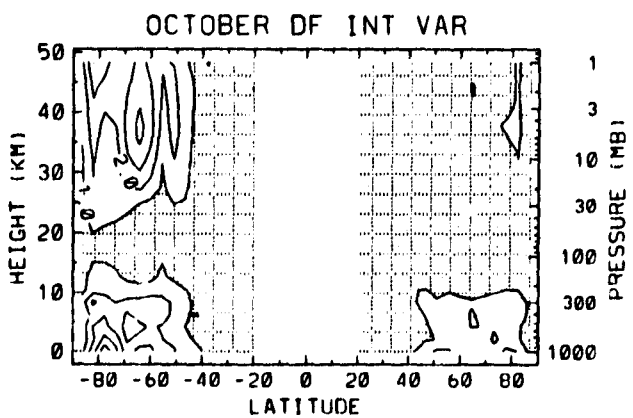
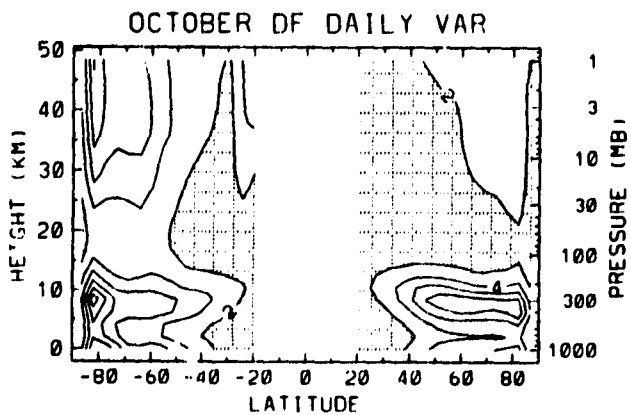
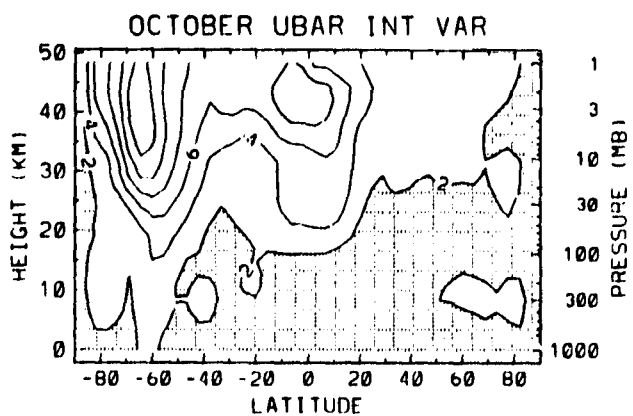
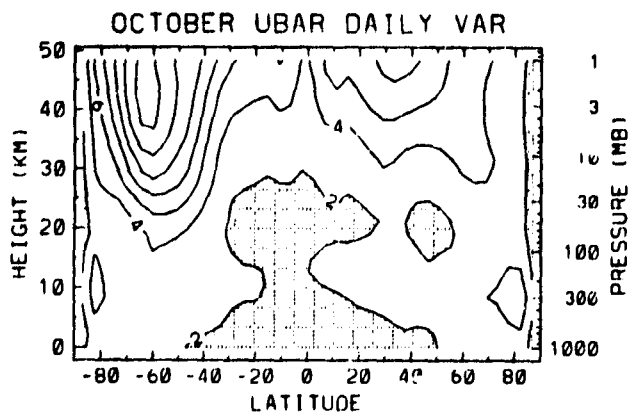
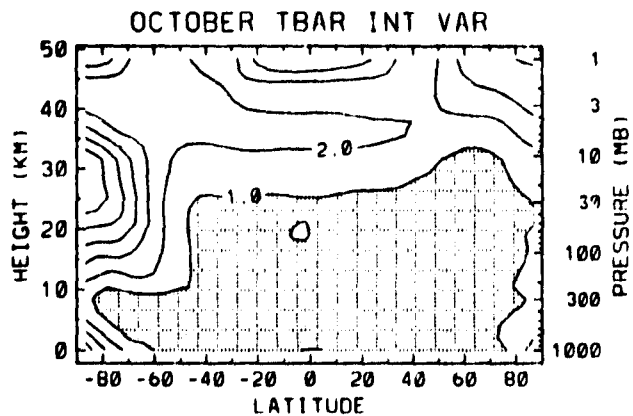
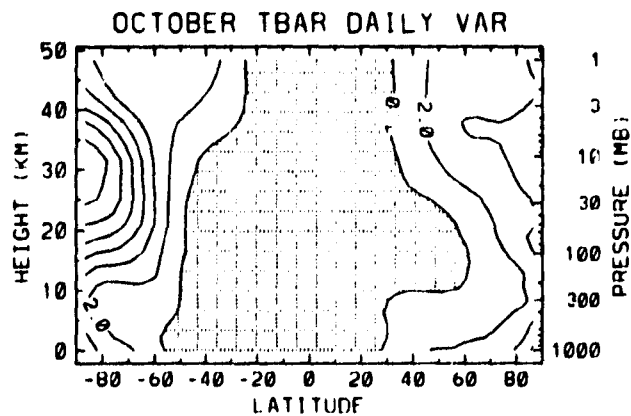


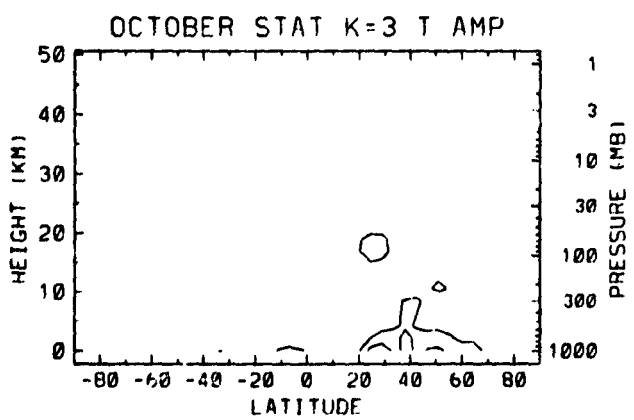
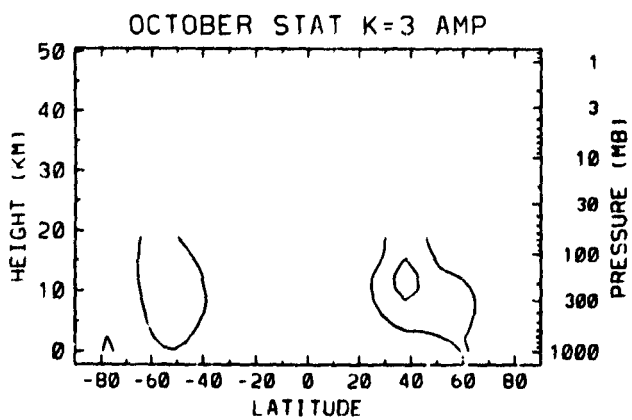
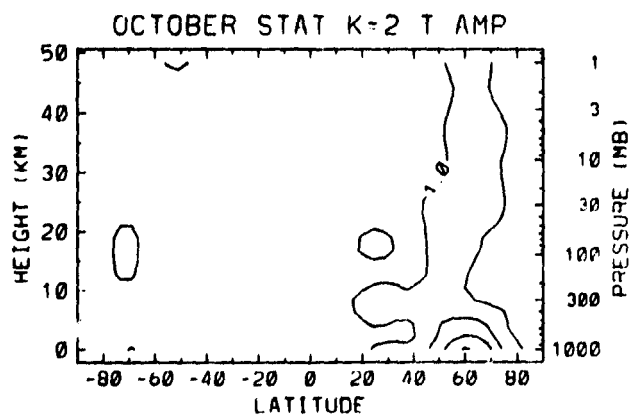
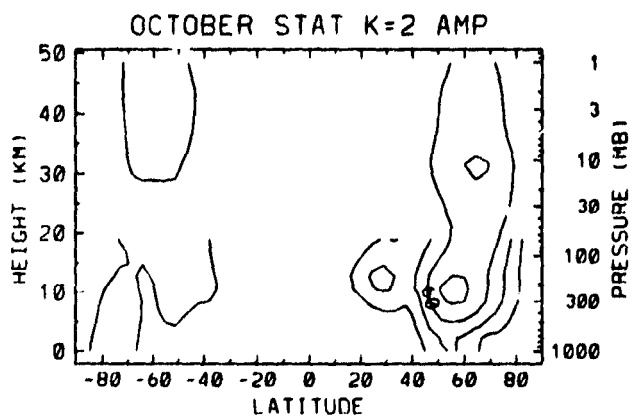
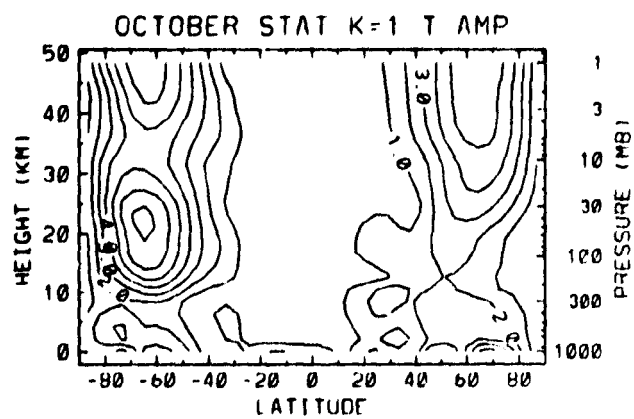
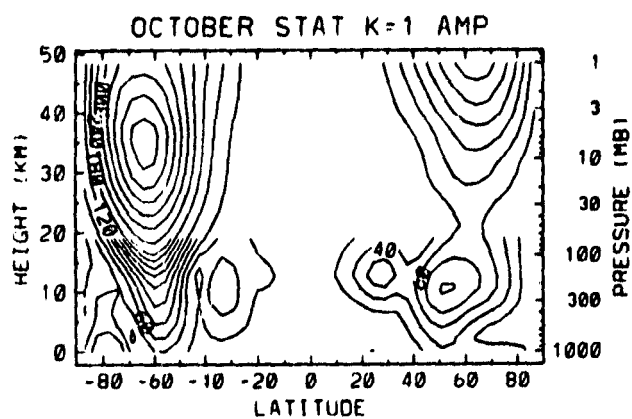


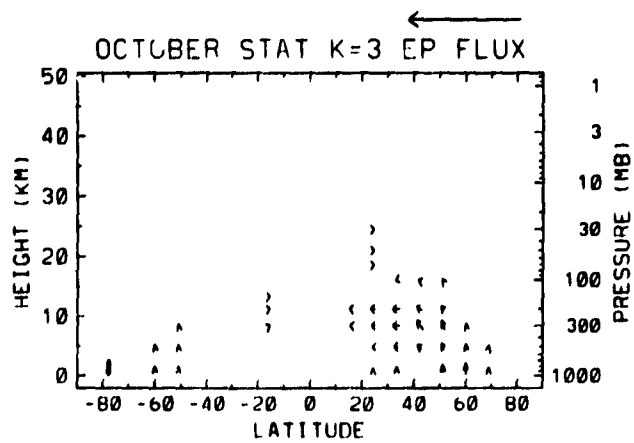
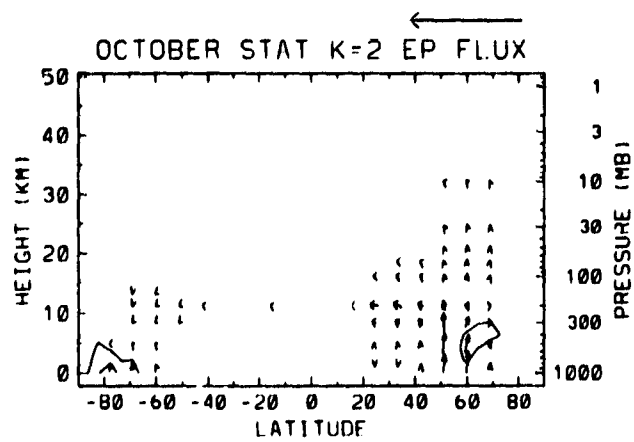
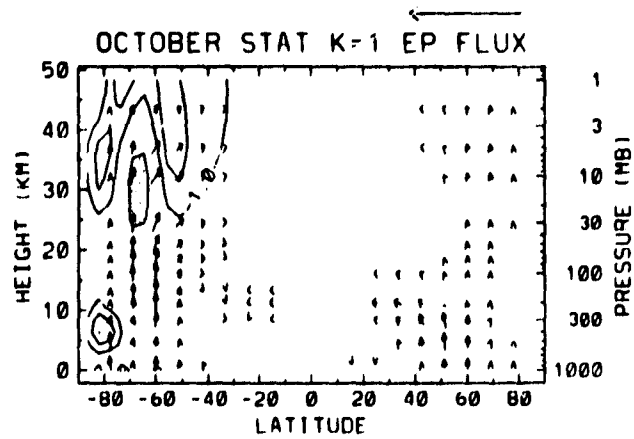


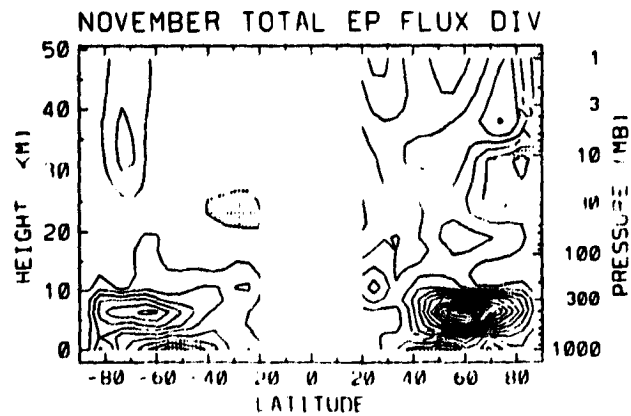
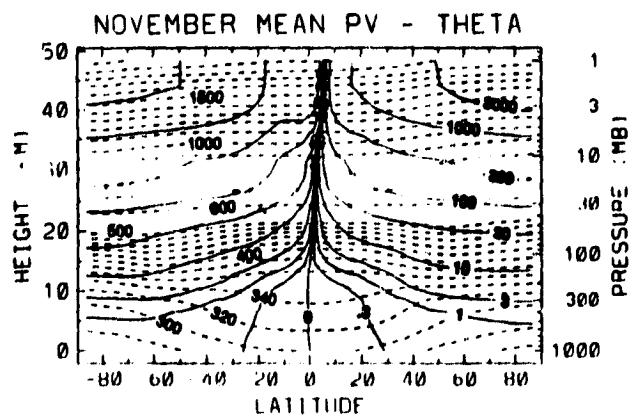
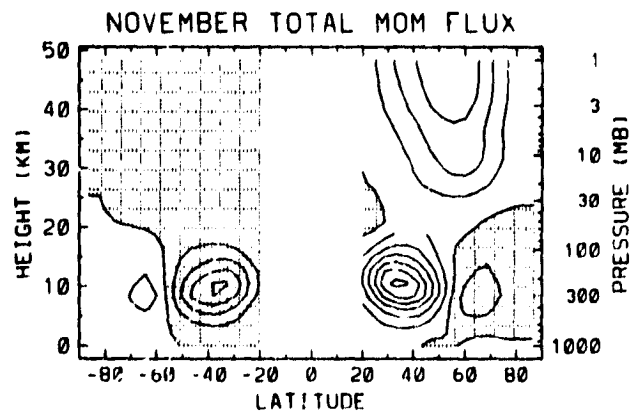
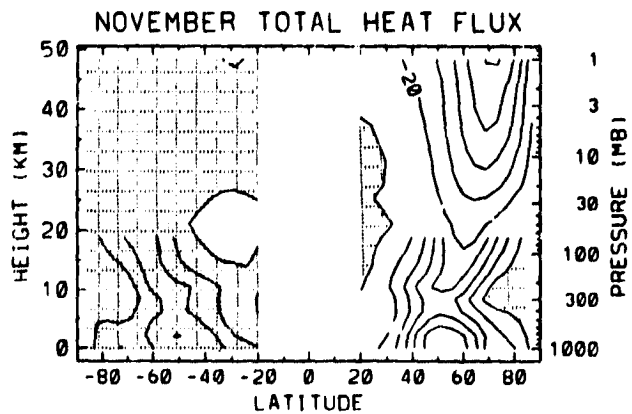
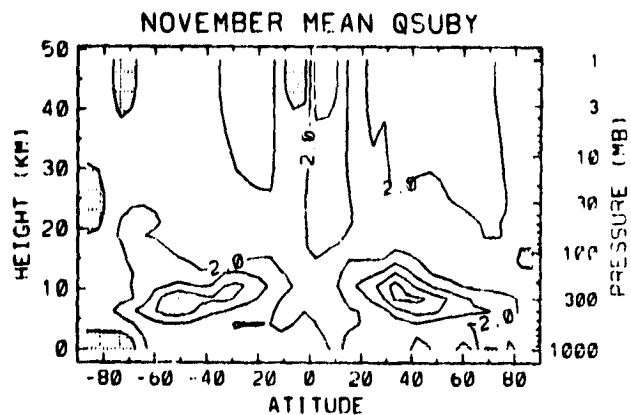
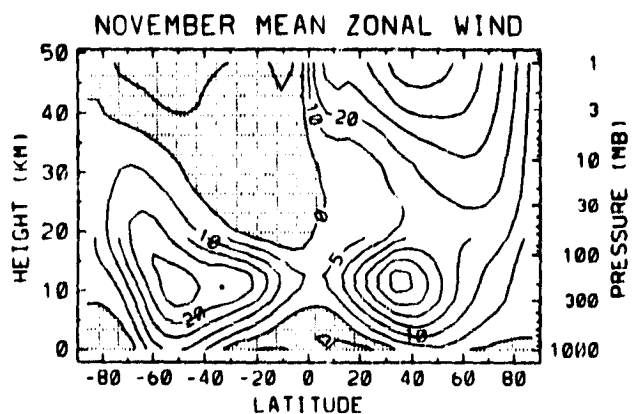
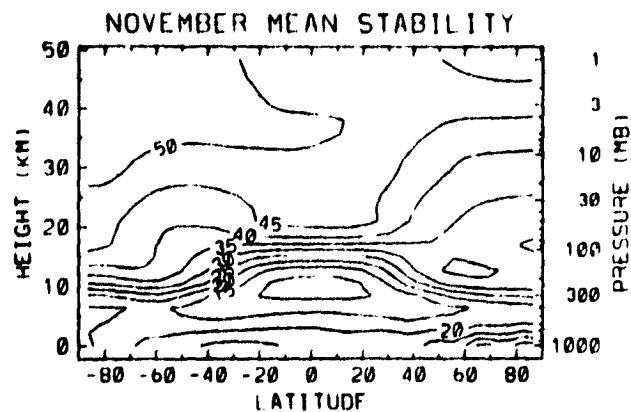
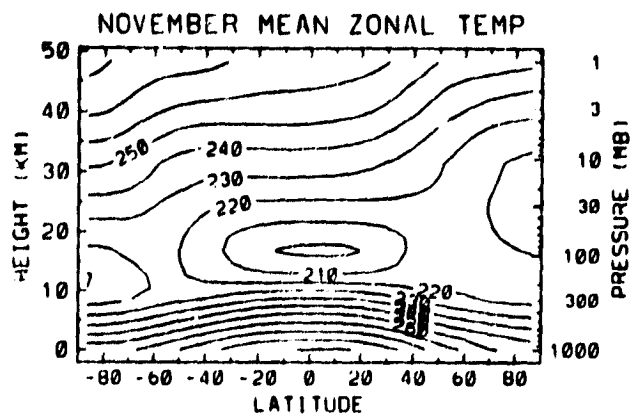


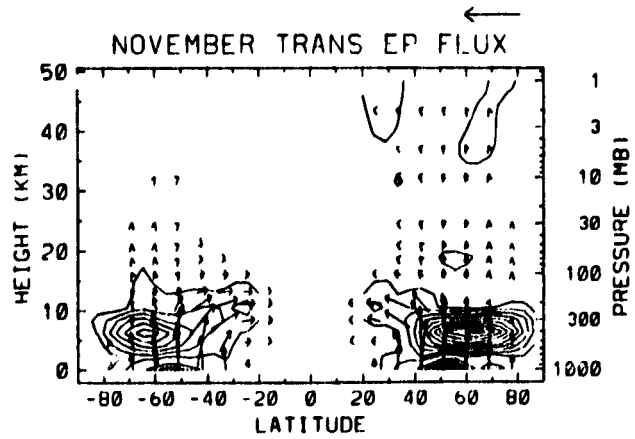
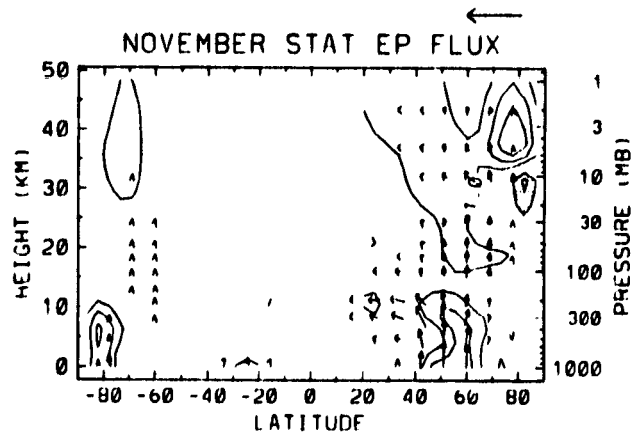
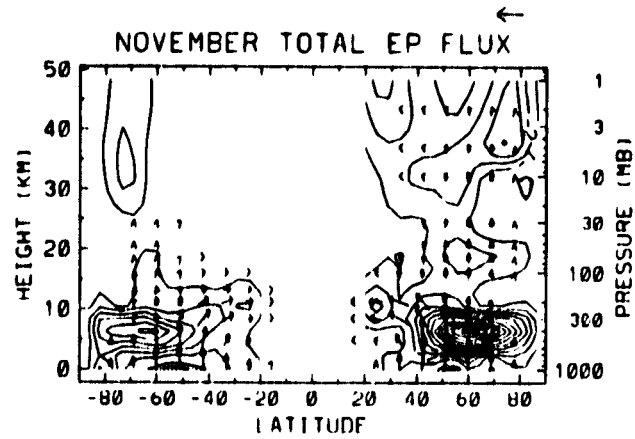


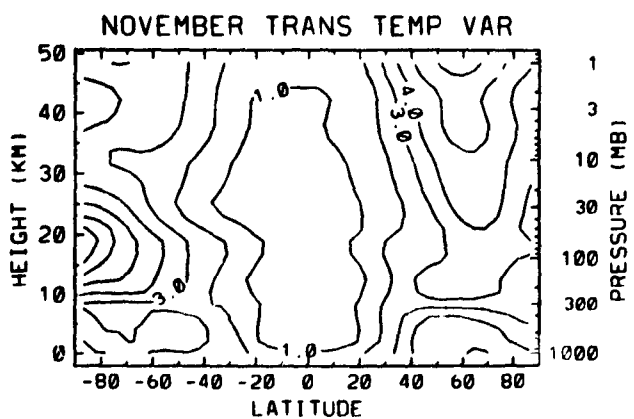
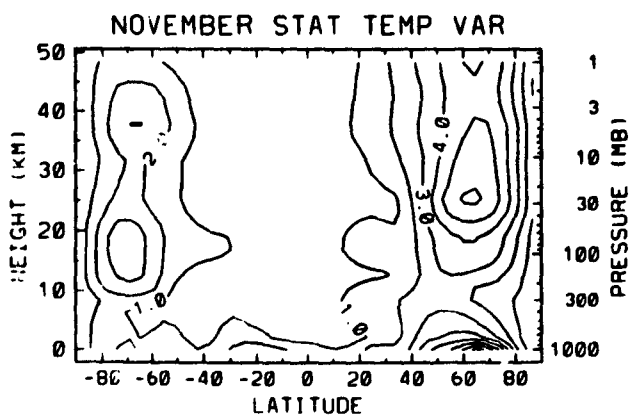
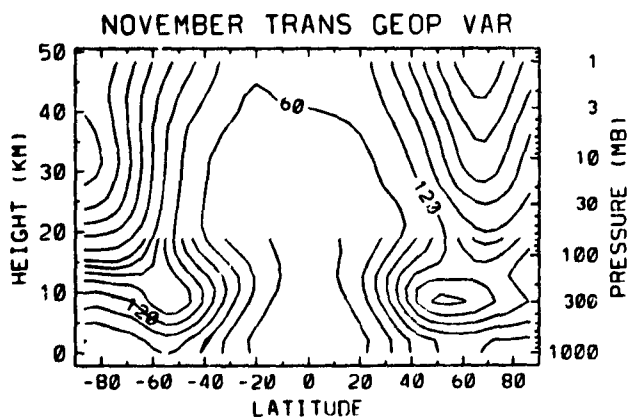
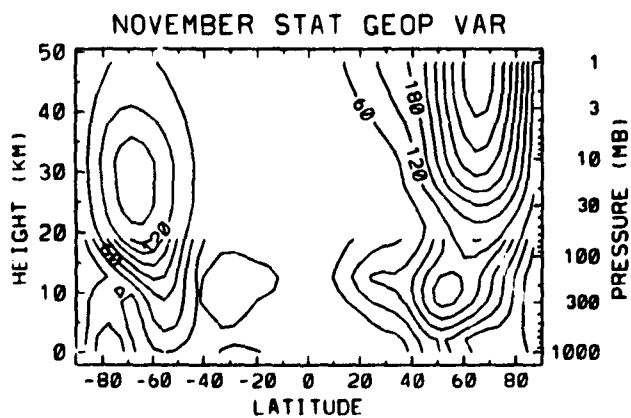
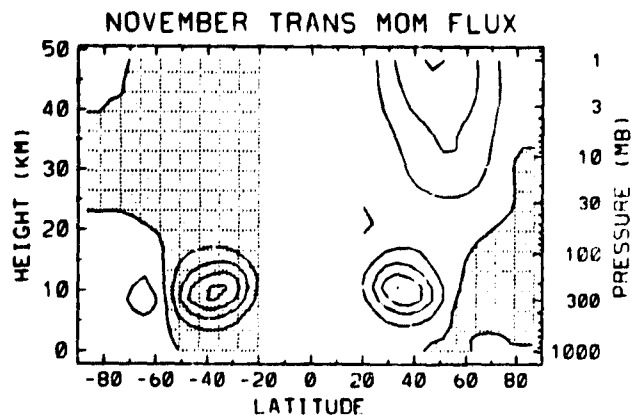
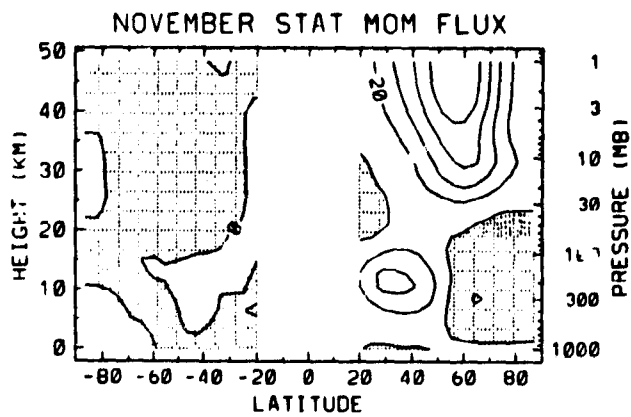
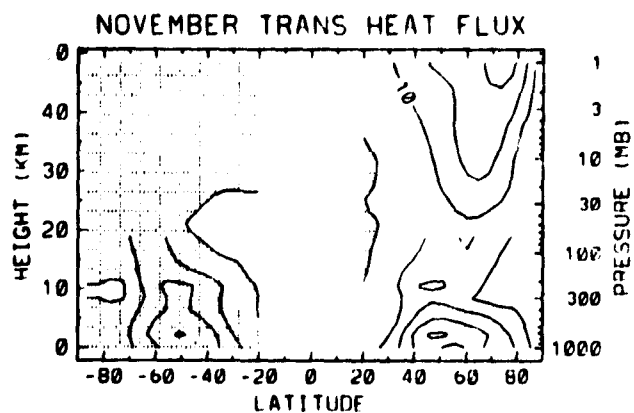
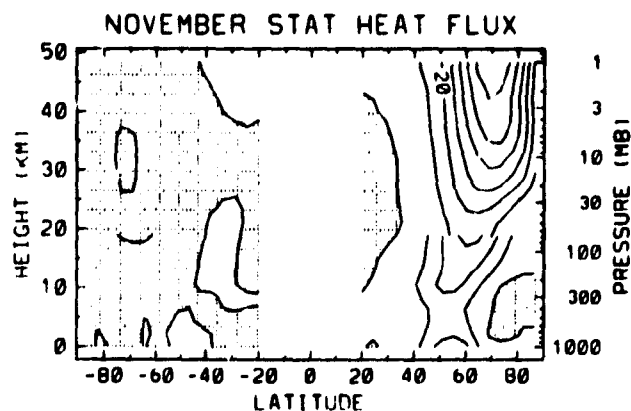


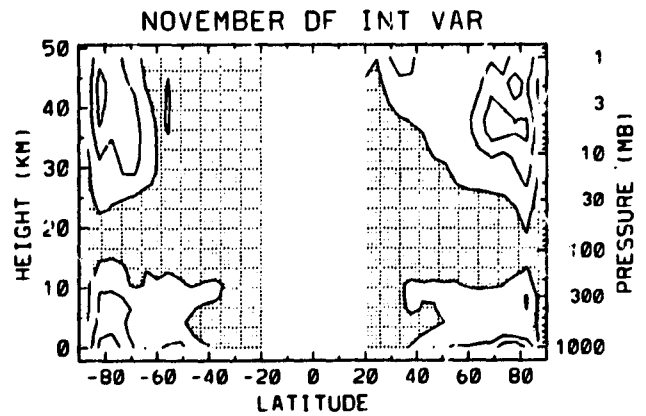
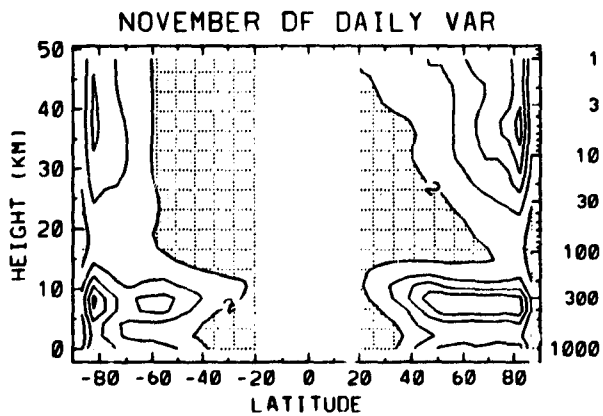
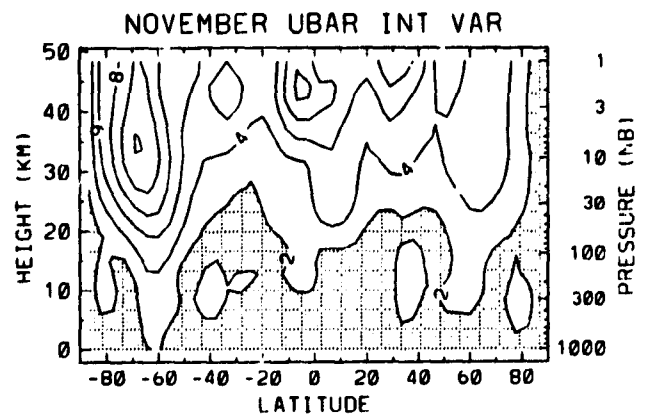
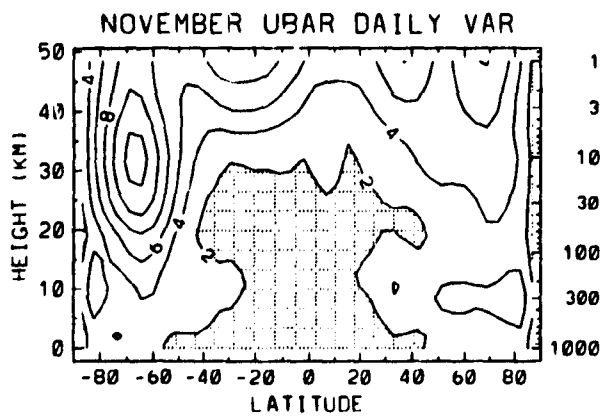
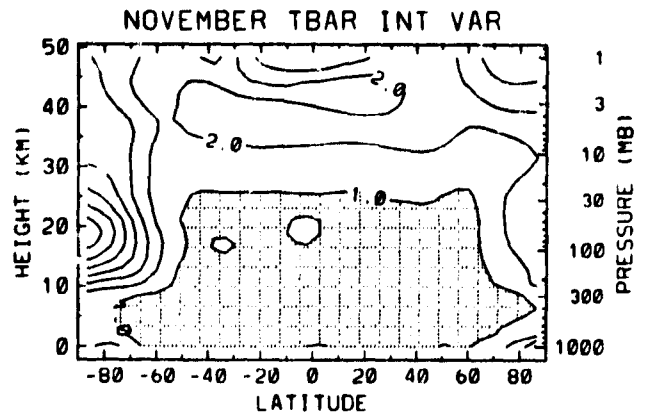
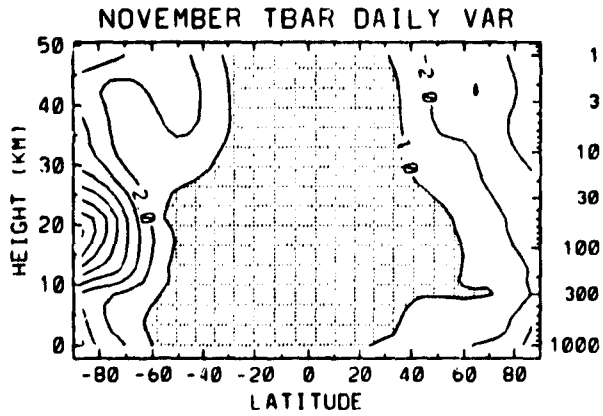


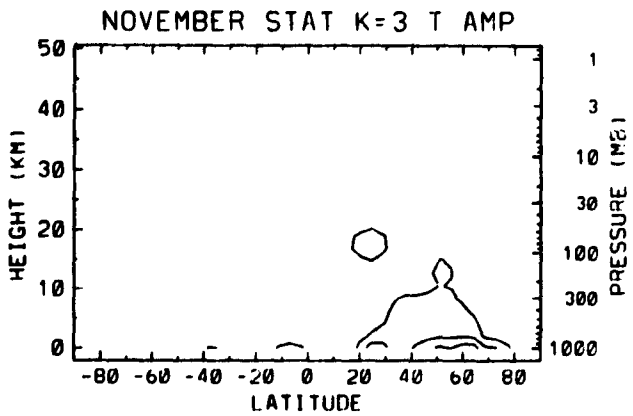
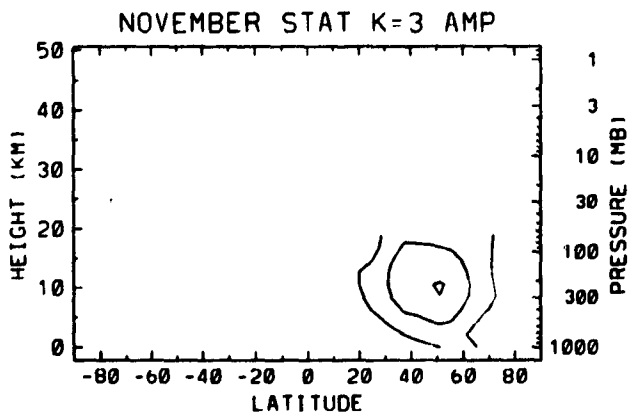
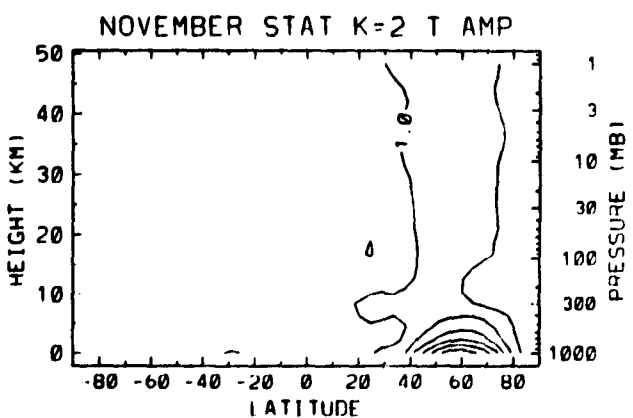
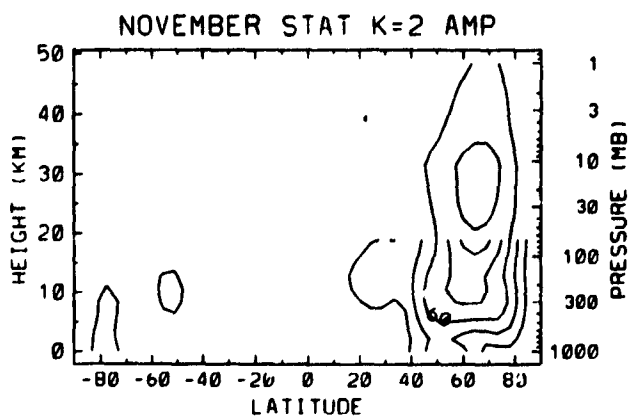
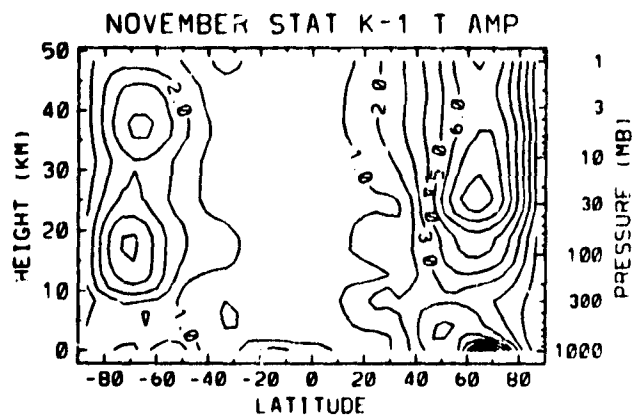
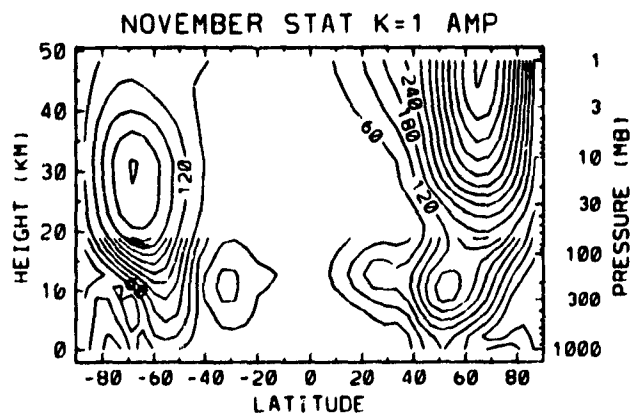


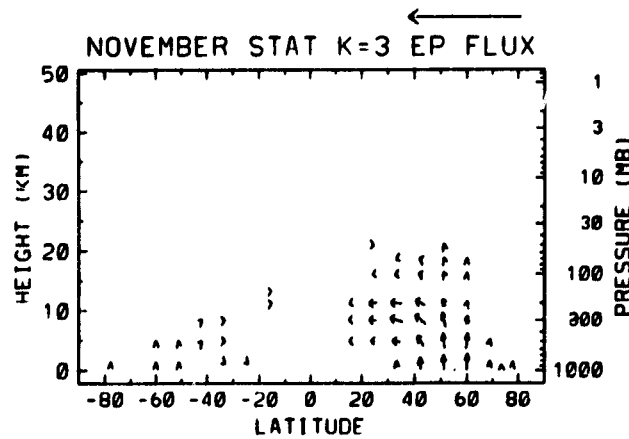
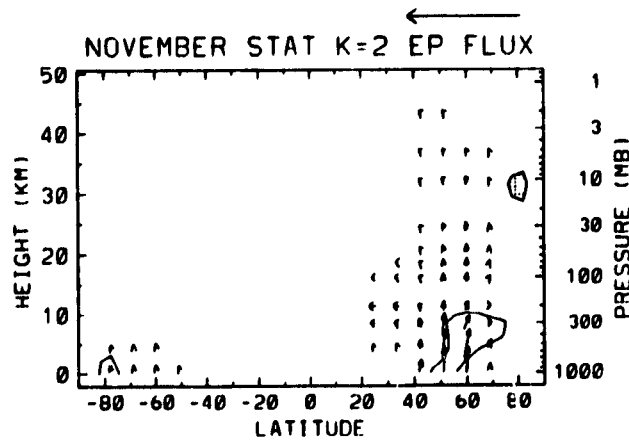
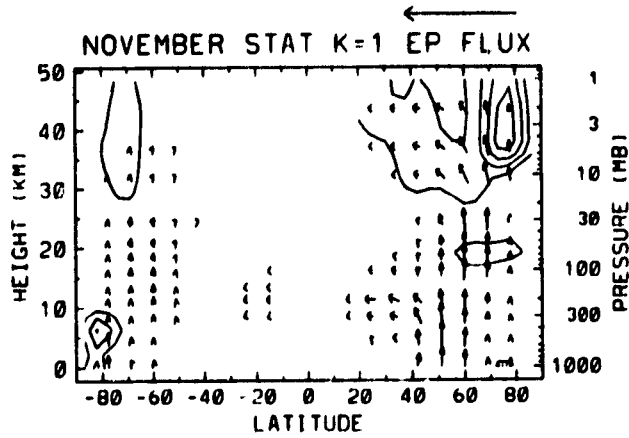


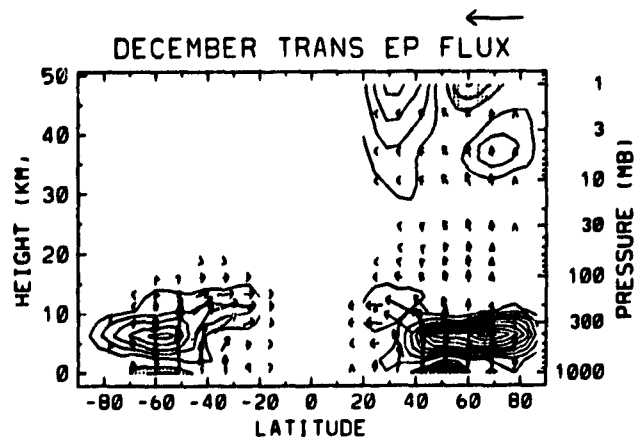
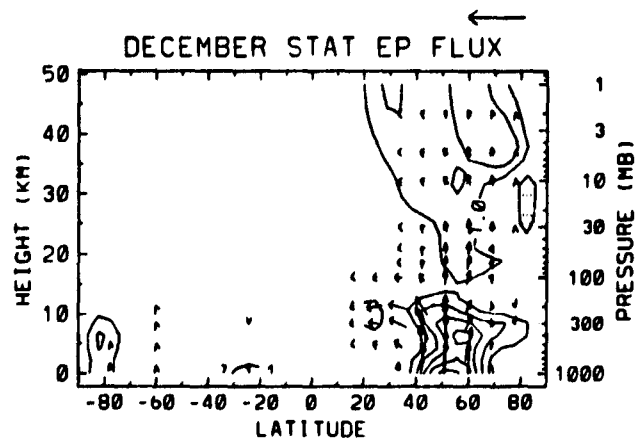
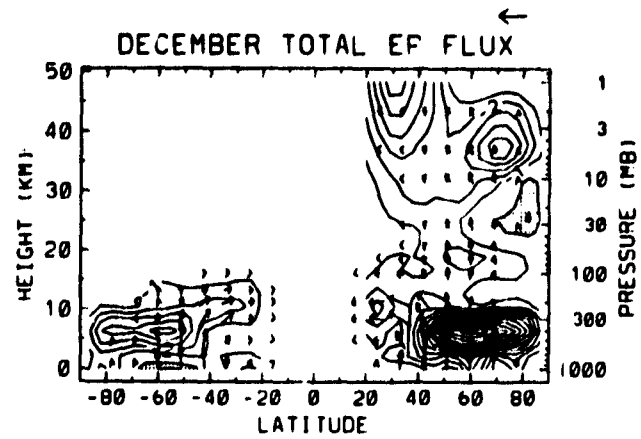


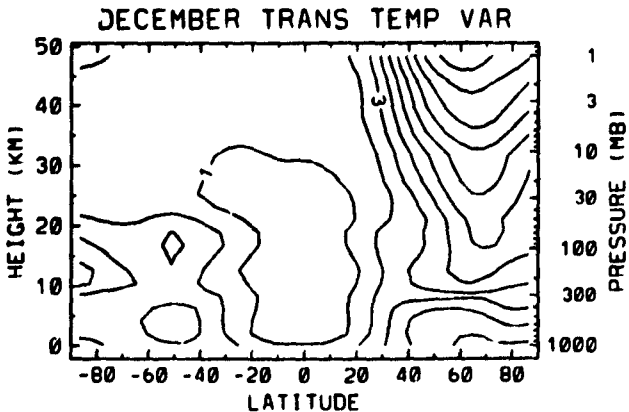
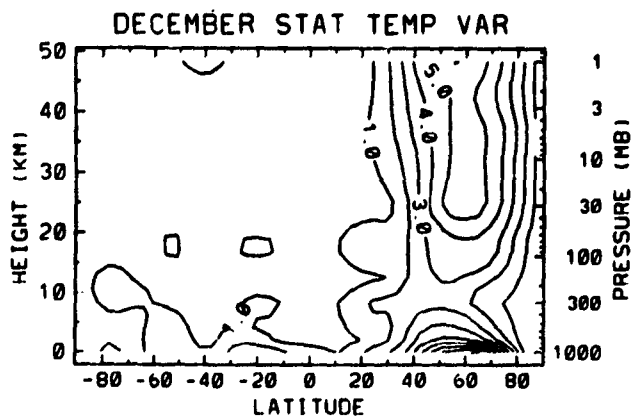
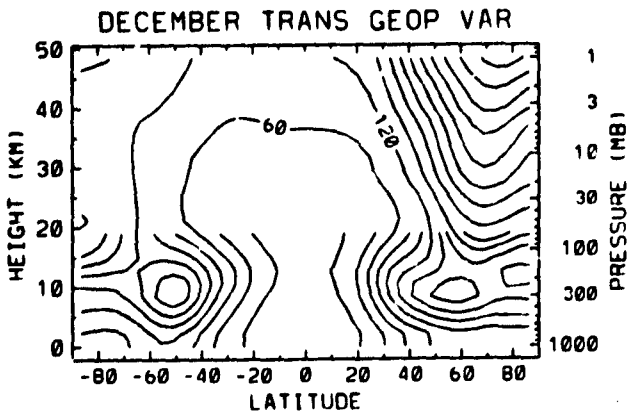
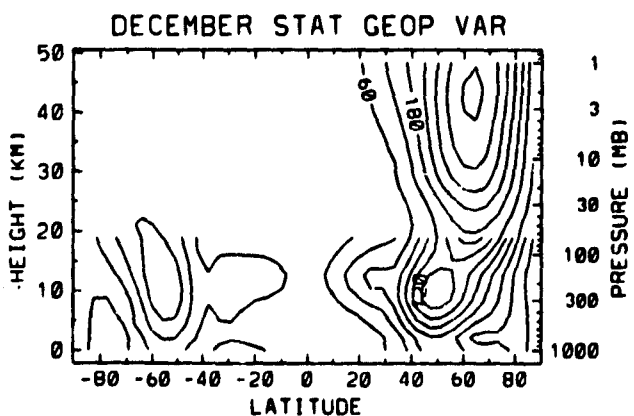
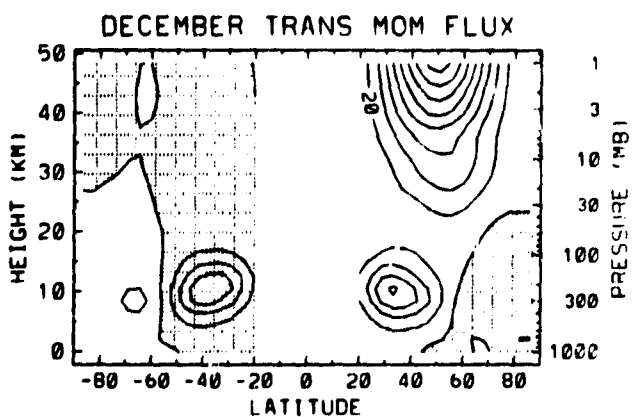
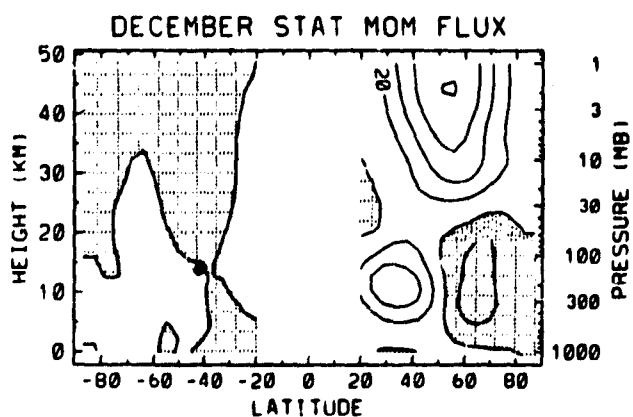
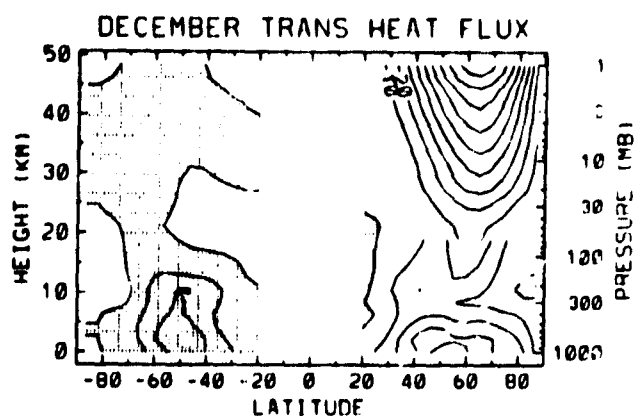
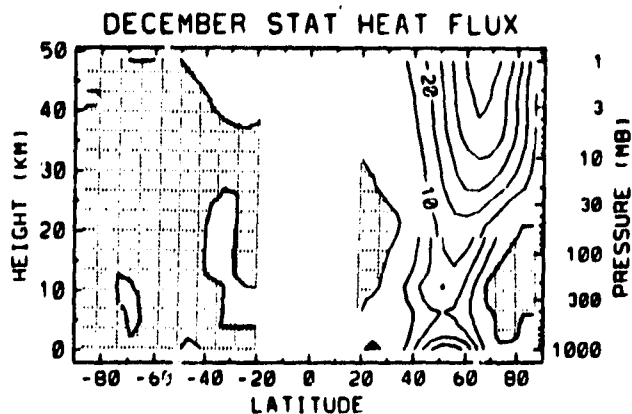


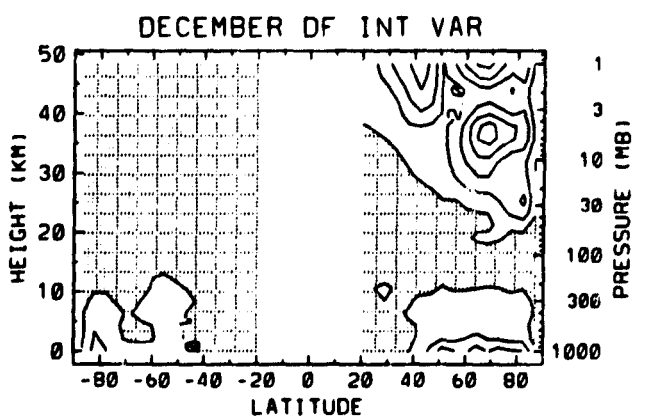
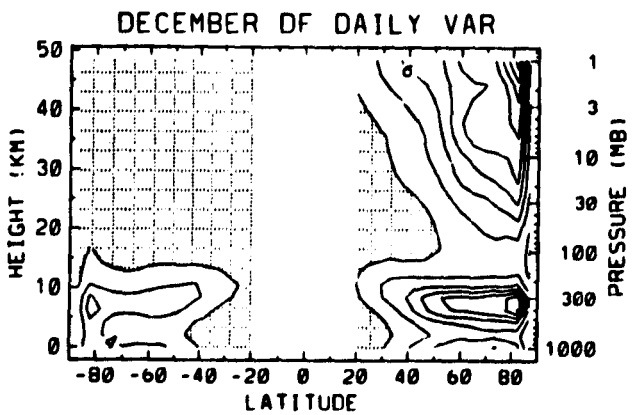
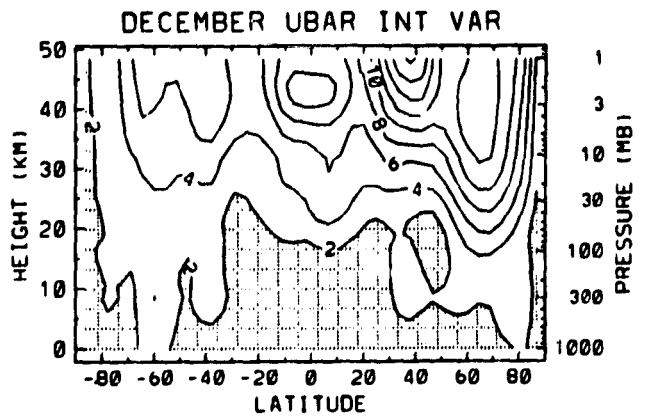
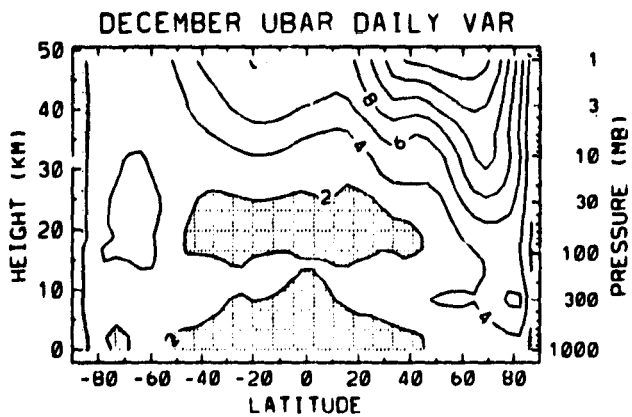
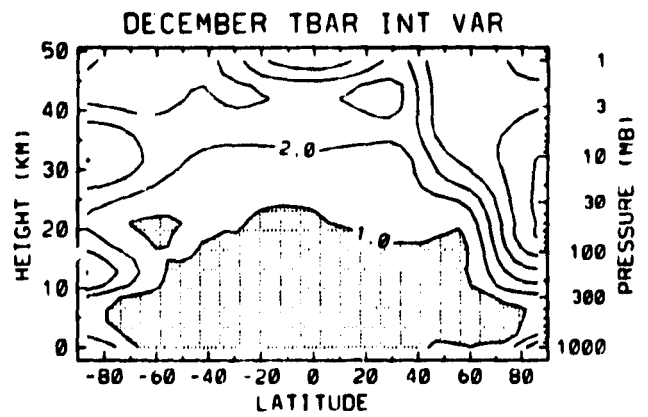
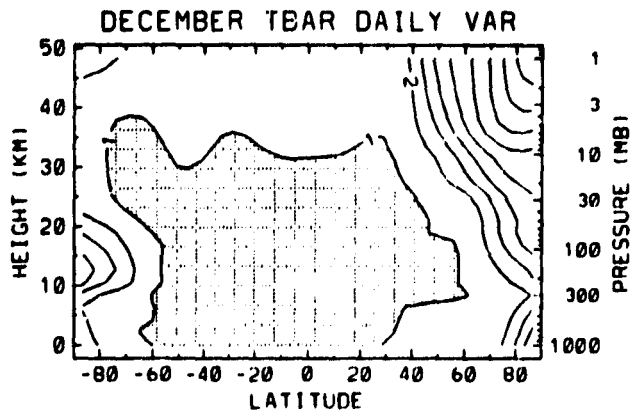


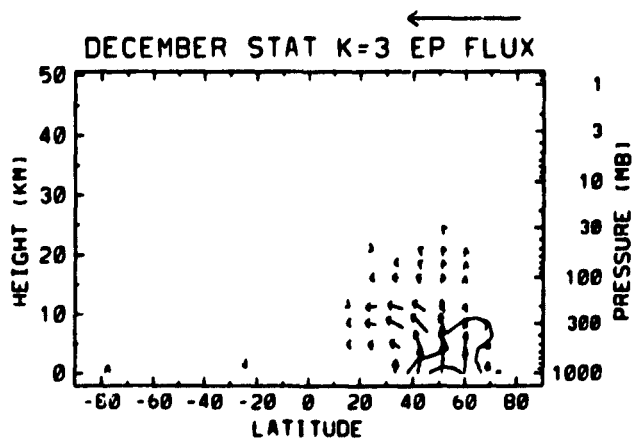
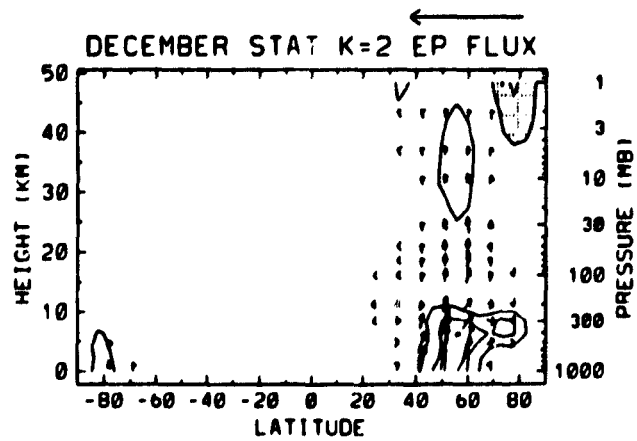
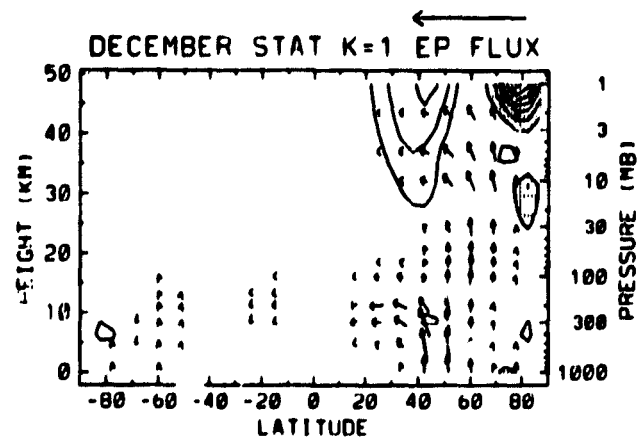










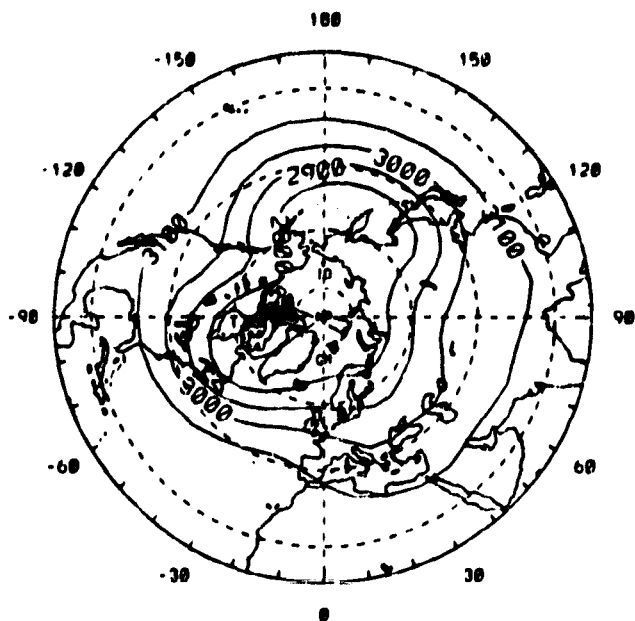


**HEMISPHERIC POLAR PROJECTIONS FOR JANUARY, APRIL, JULY
AND OCTOBER**

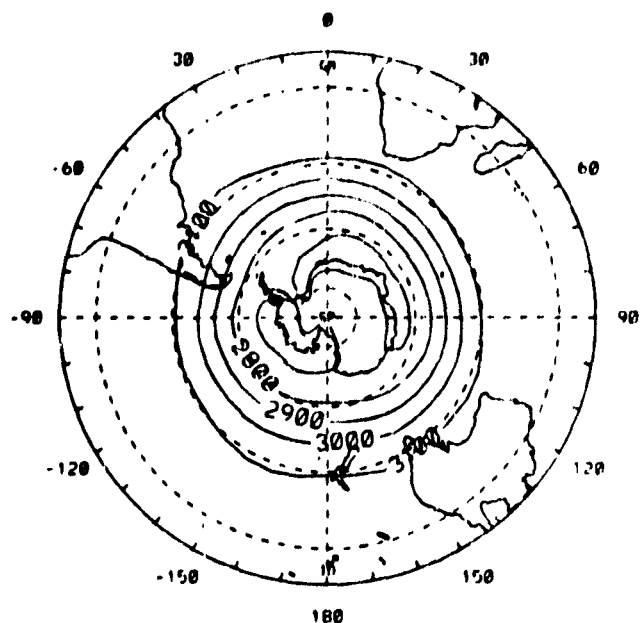
<u>Quantity</u>	<u>Units</u>
Monthly average geopotential heights	(m)
Monthly average daily geopotential height standard deviation	(m)
Monthly average wind speed isotachs $(u^2 + v^2)^{1/2}$	(m/s)
Monthly average temperature	(K)

Note: These polar stereographic plots cover approximately 15°-pole for each hemisphere, with latitudes of 20°, 40°, 60° and 80° noted as dashed lines.

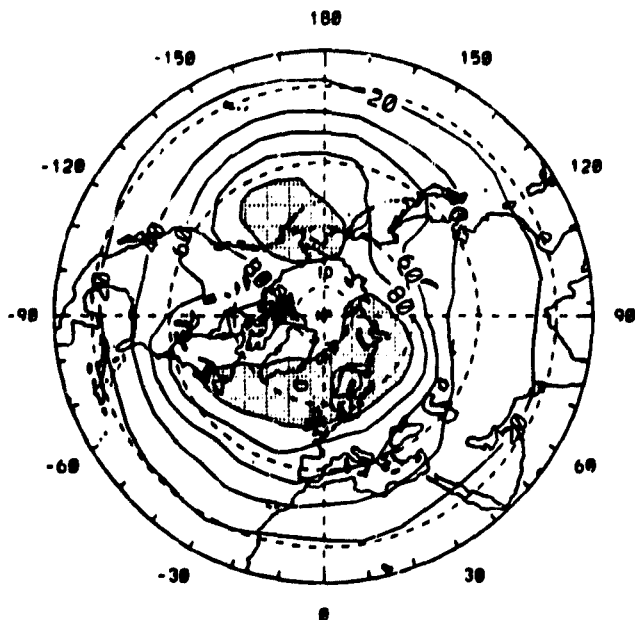
JANUARY NH 700 MB HEIGHT



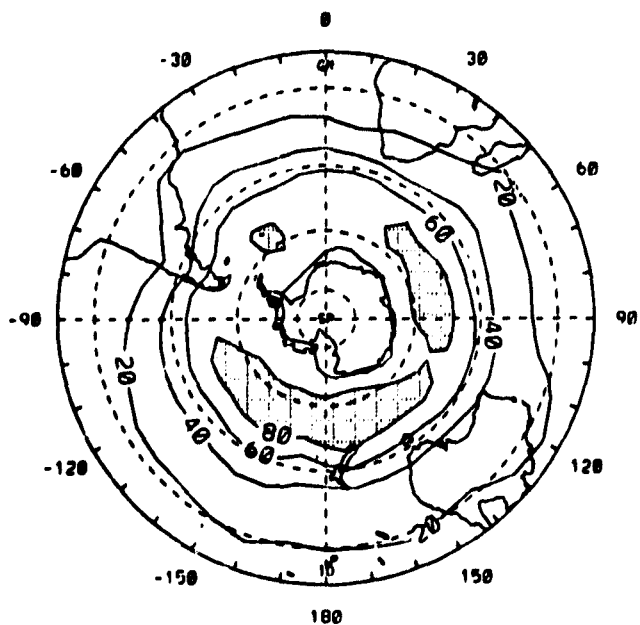
JANUARY SH 700 MB HEIGHT



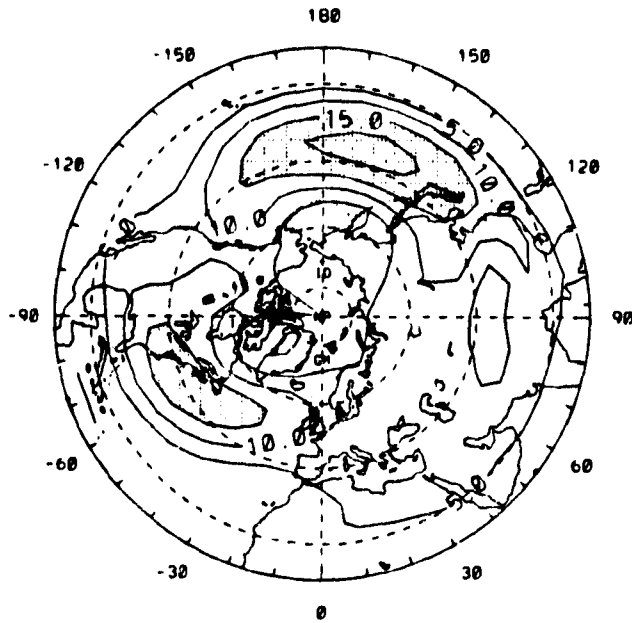
JANUARY NH 700 MB GEOP VAR



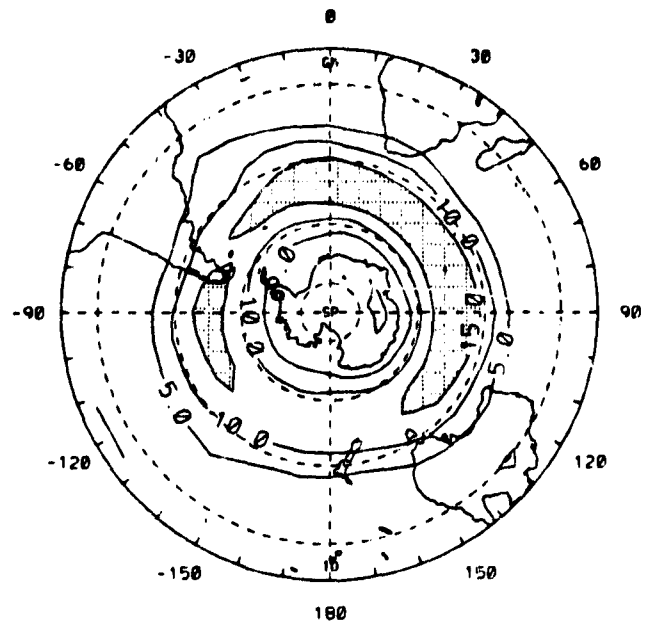
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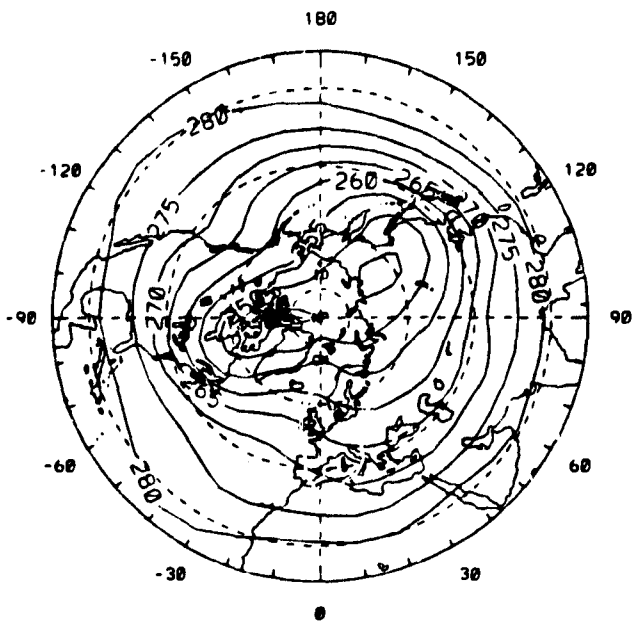
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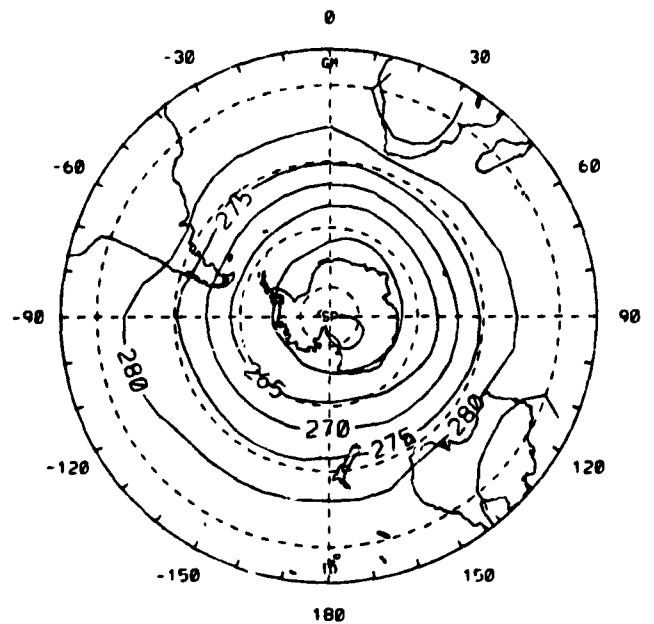
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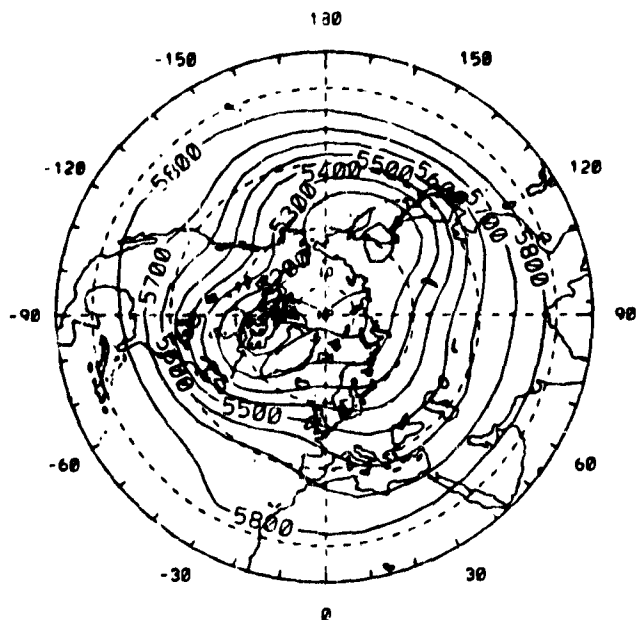
JANUARY NH 700 MB TEMPERATURE



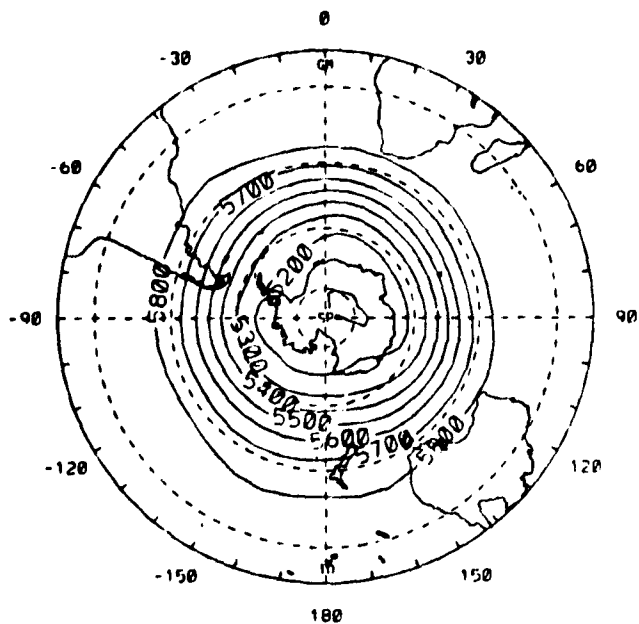
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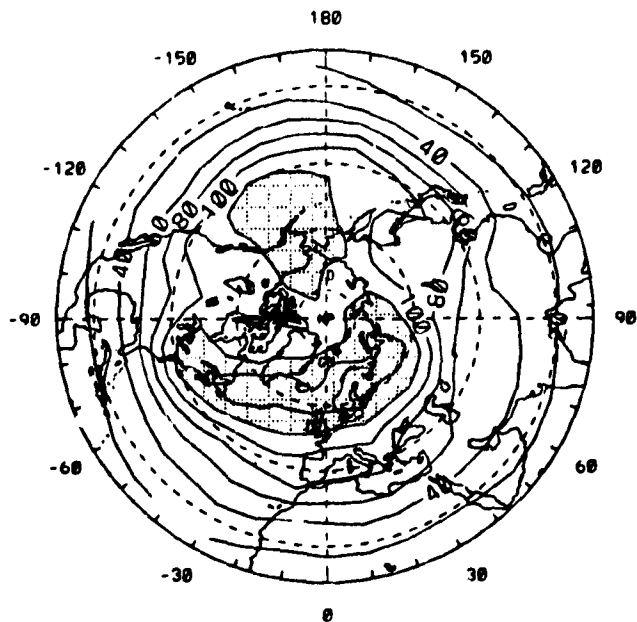
JANUARY NH 500 MB HEIGHT



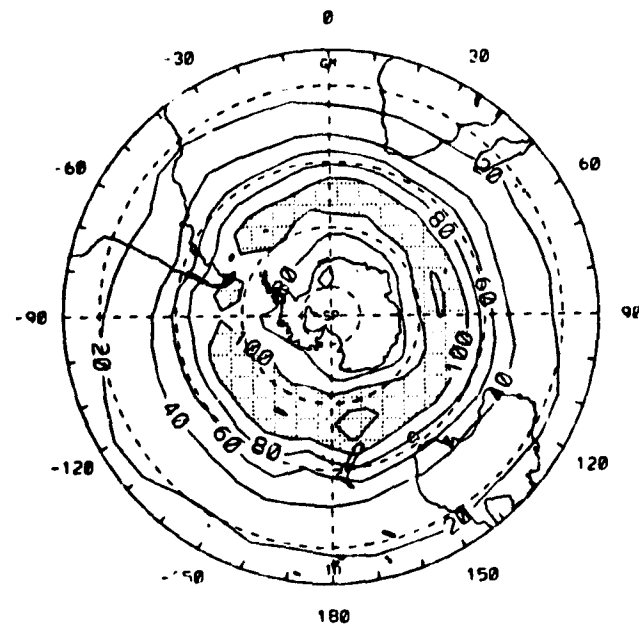
JANUARY SH 500 MB HEIGHT



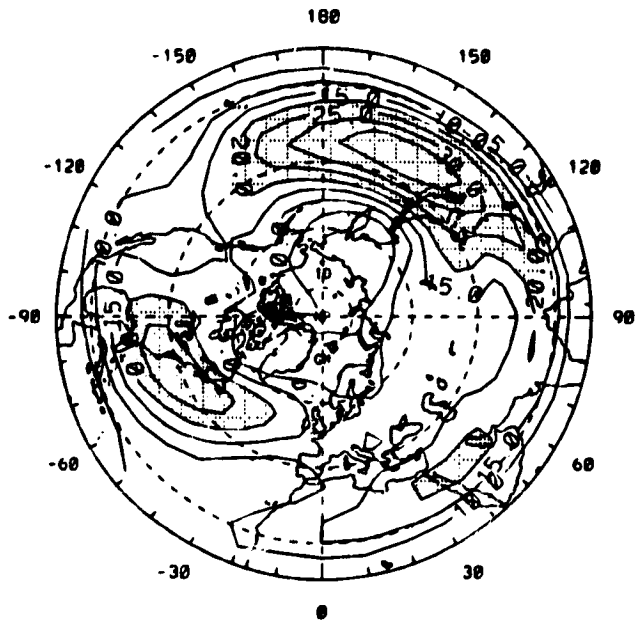
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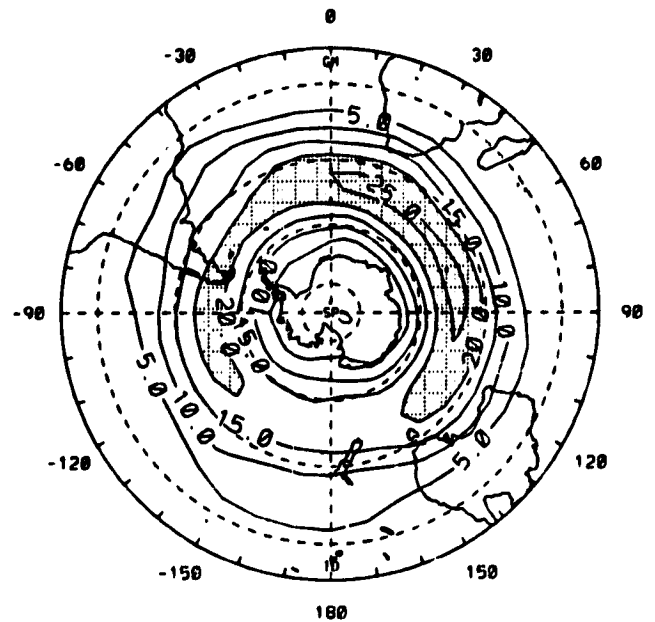
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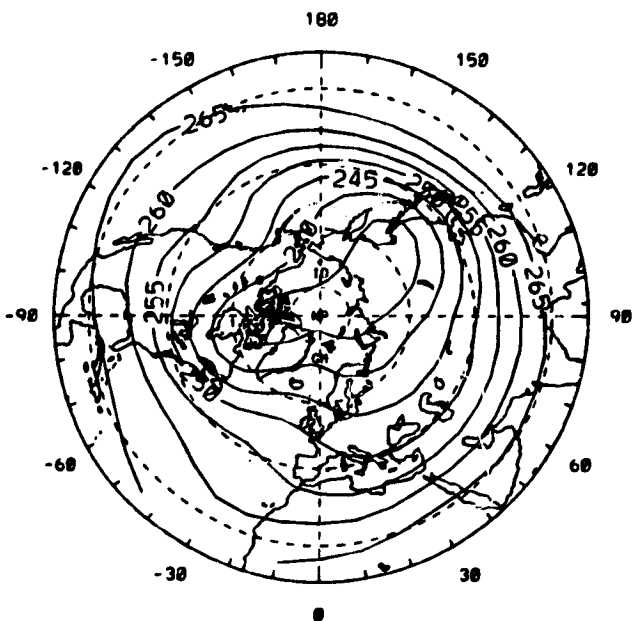
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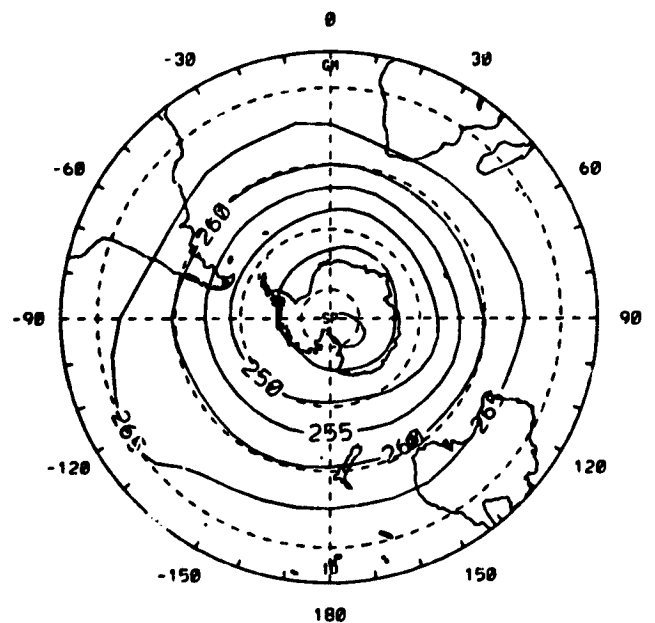
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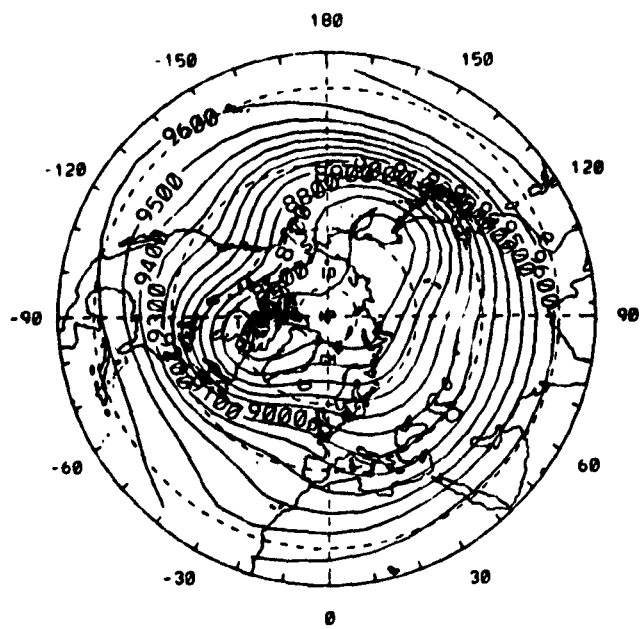
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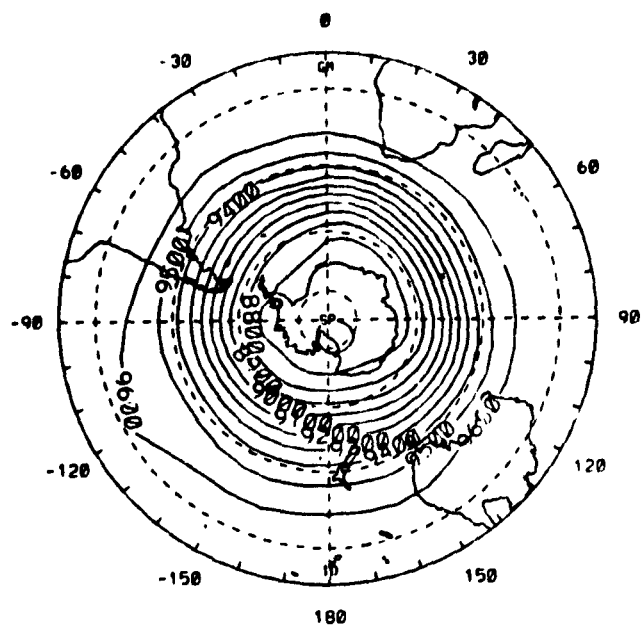
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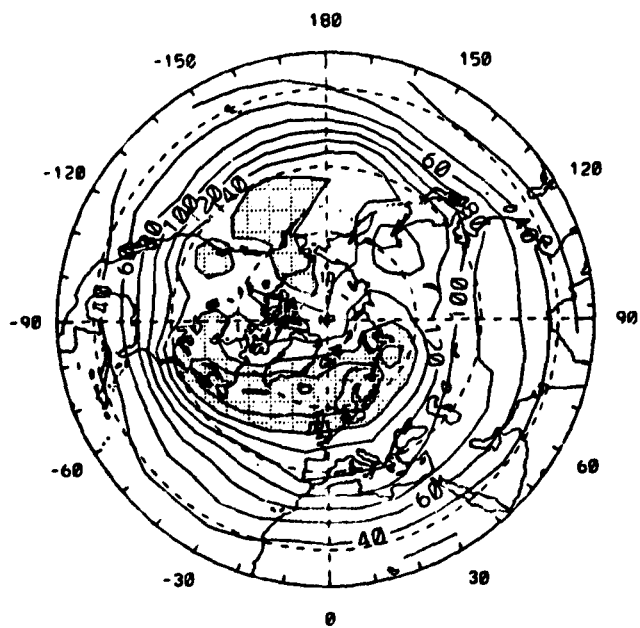
JANUARY NH 300 MB HEIGHT



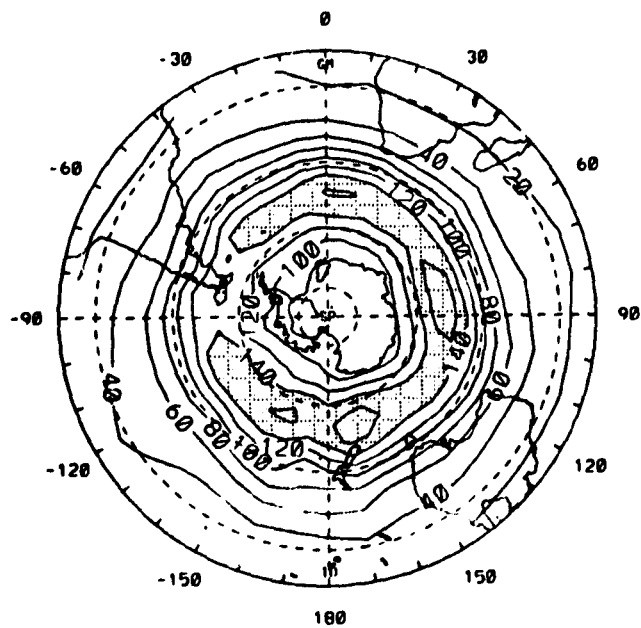
JANUARY SH 300 MB HEIGHT



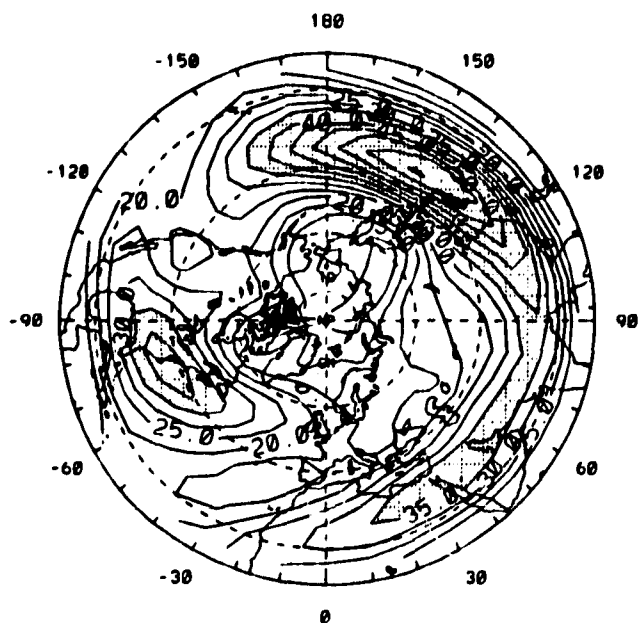
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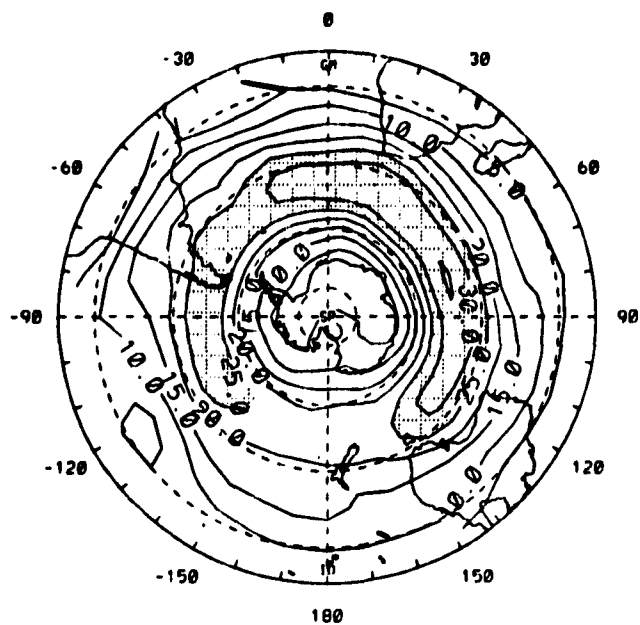
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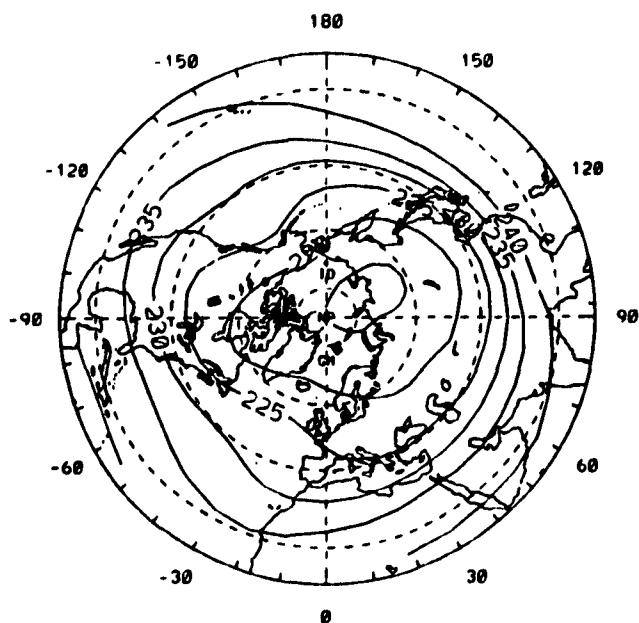
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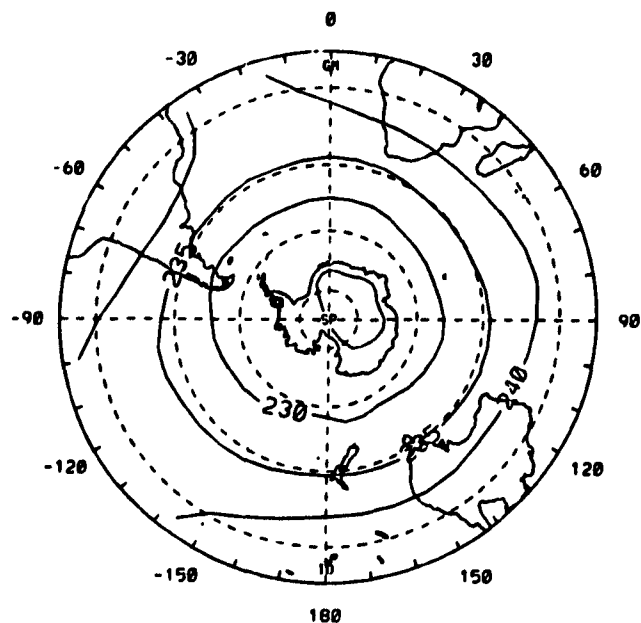
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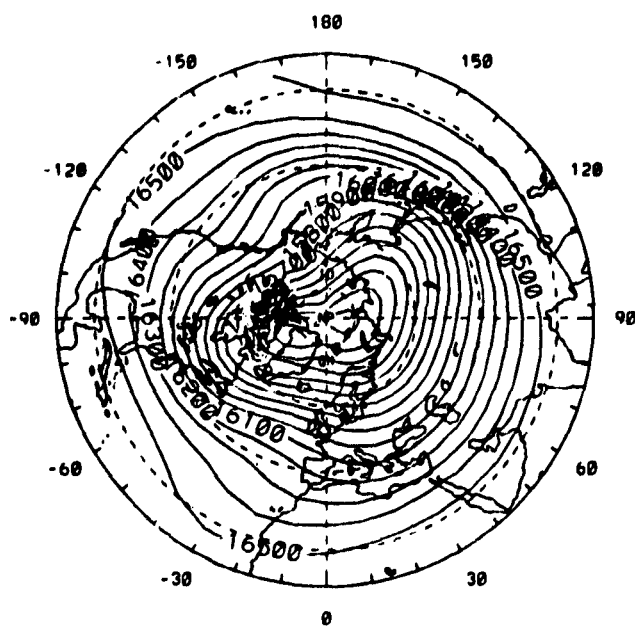
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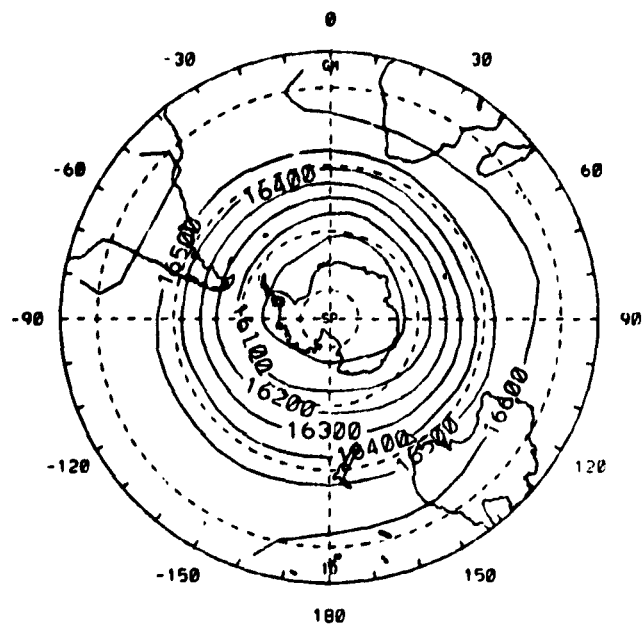
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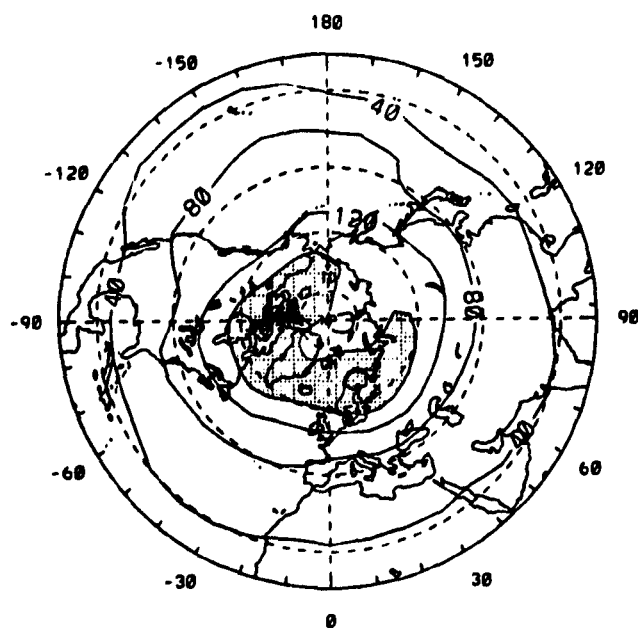
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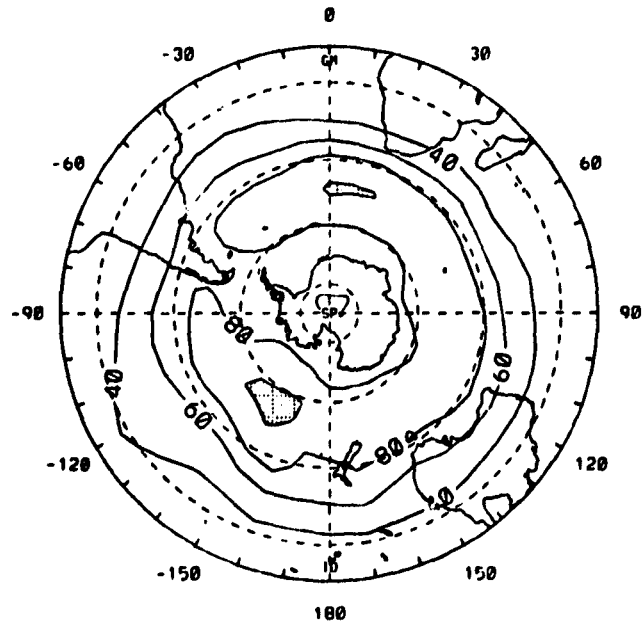
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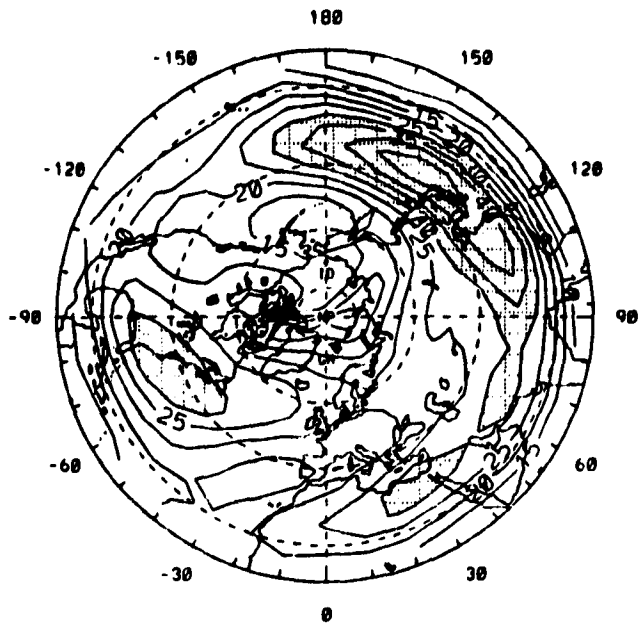
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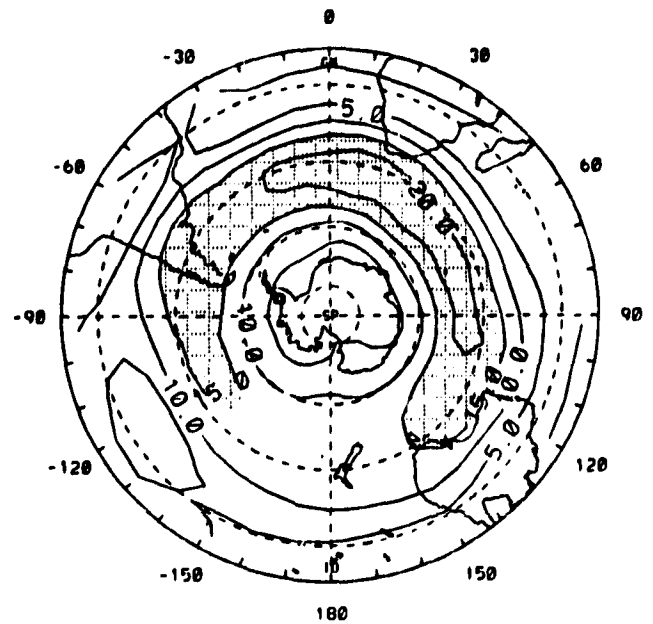
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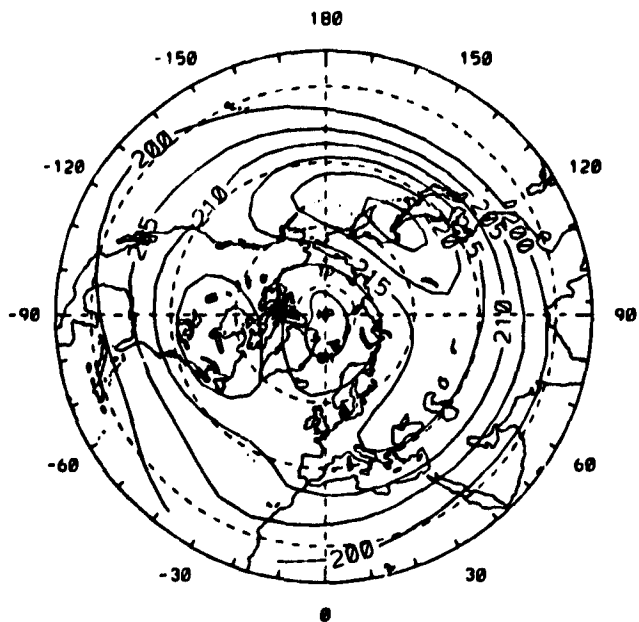
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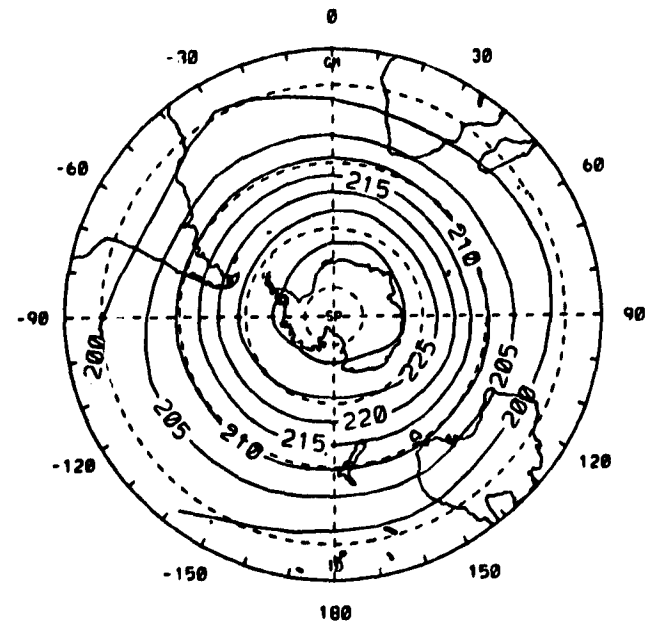
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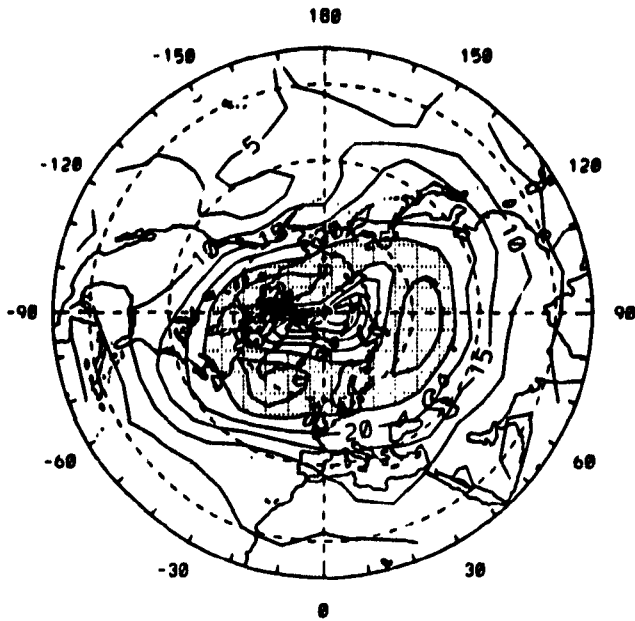
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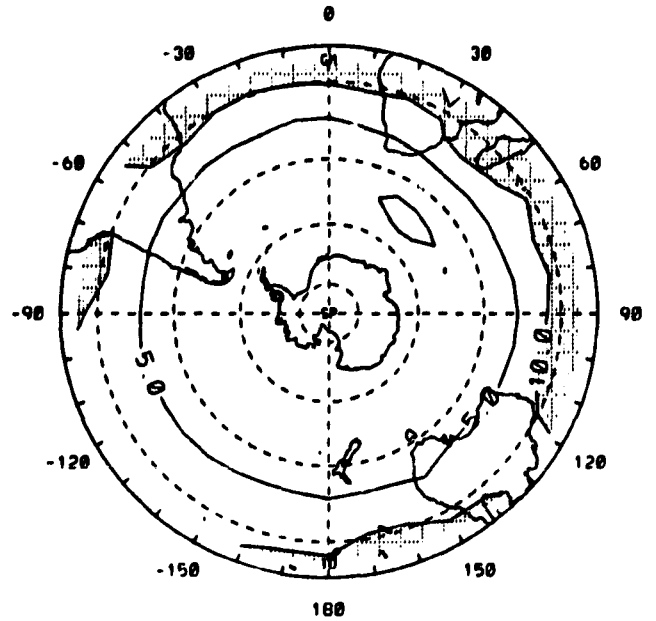
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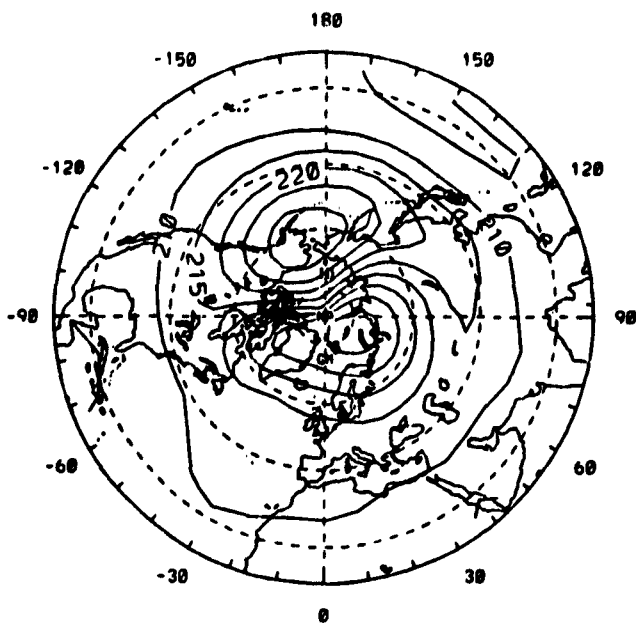
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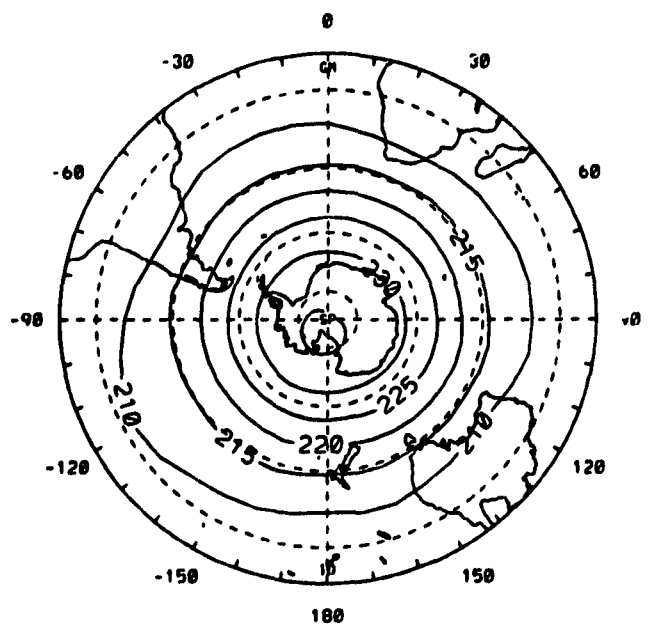
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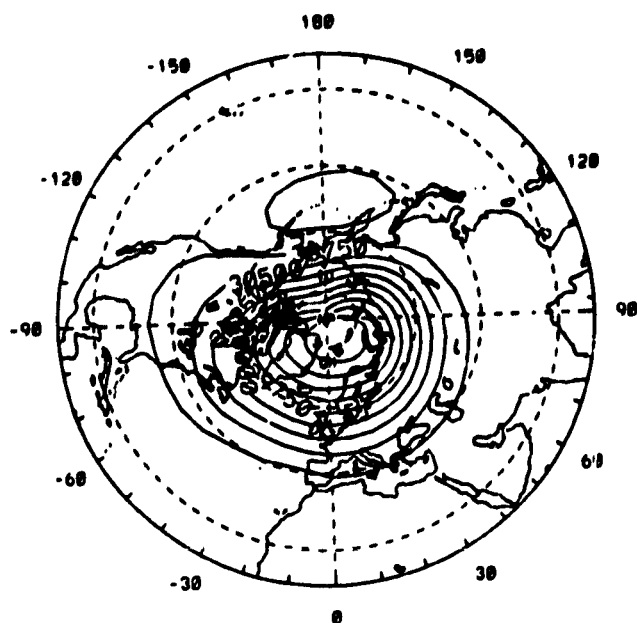
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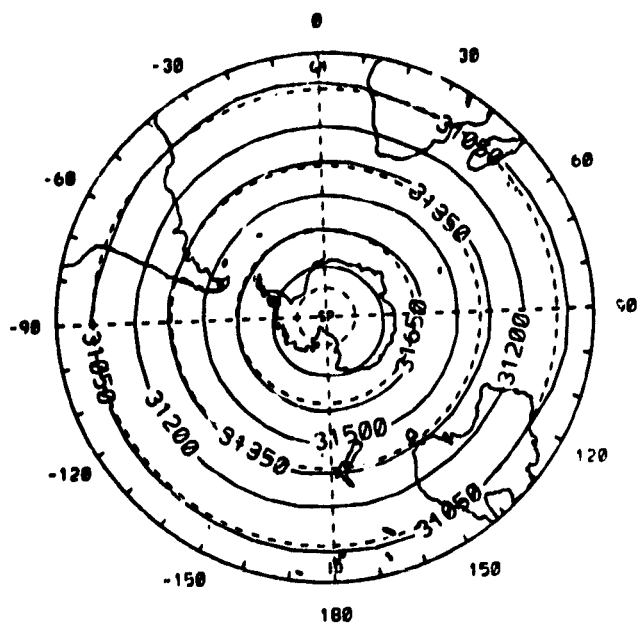
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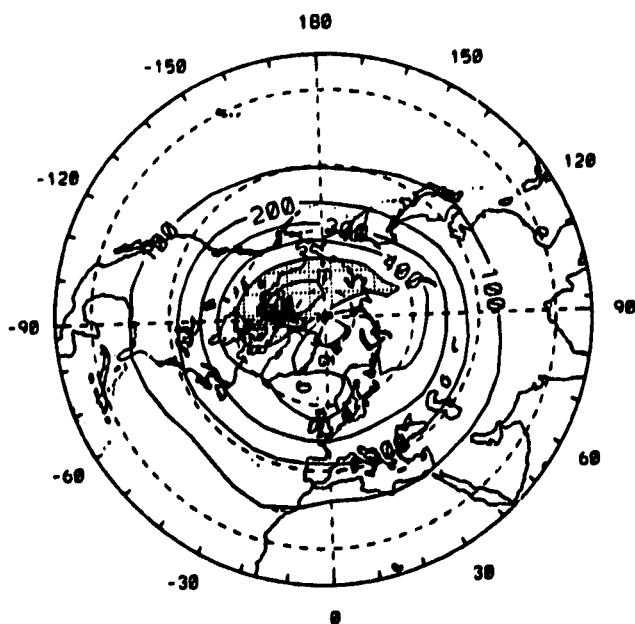
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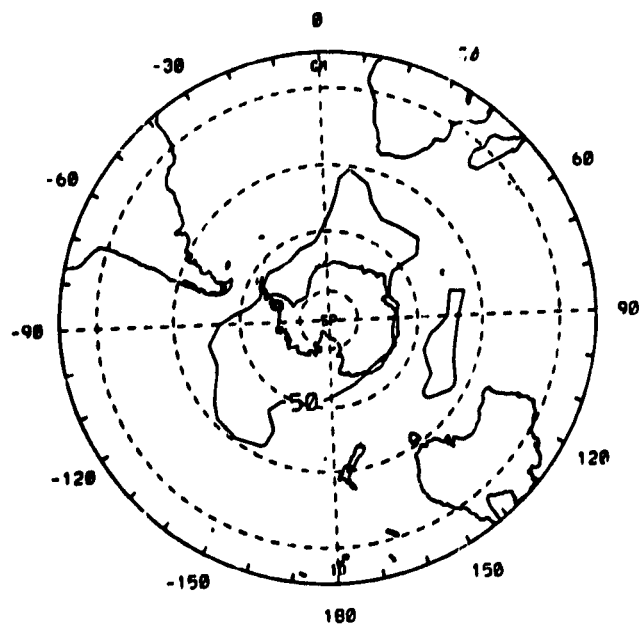
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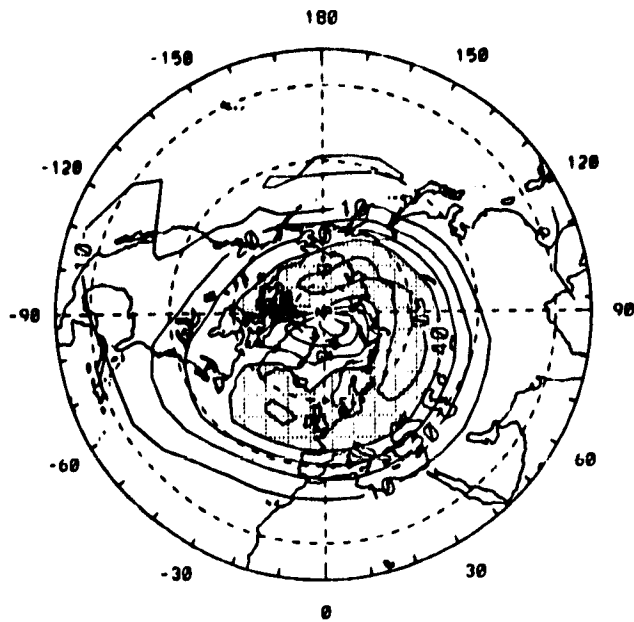
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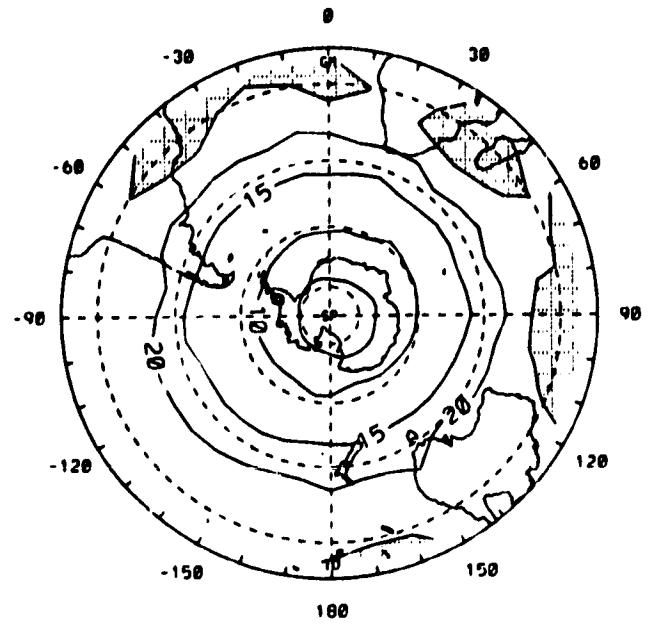
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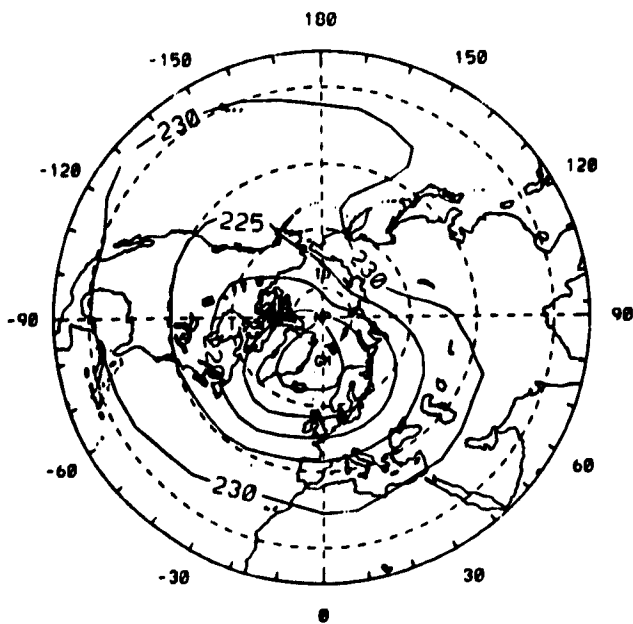
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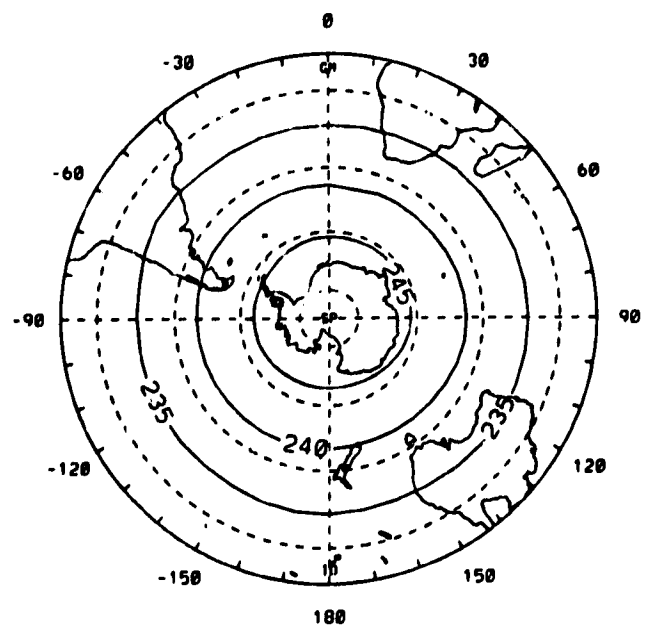
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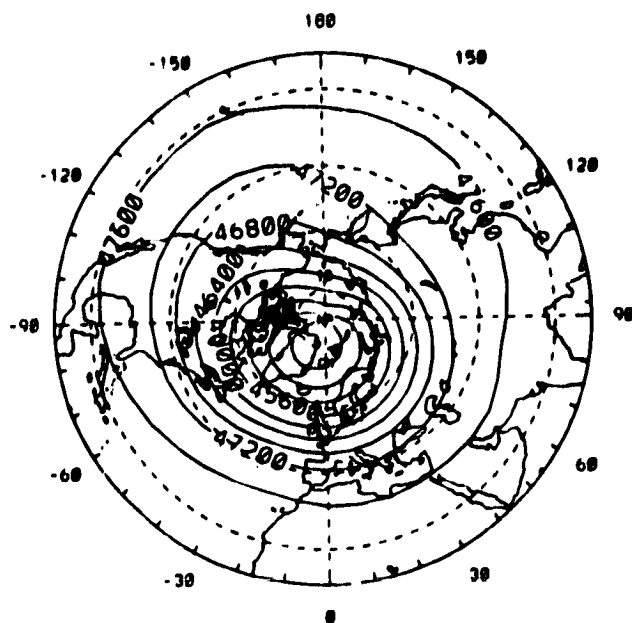
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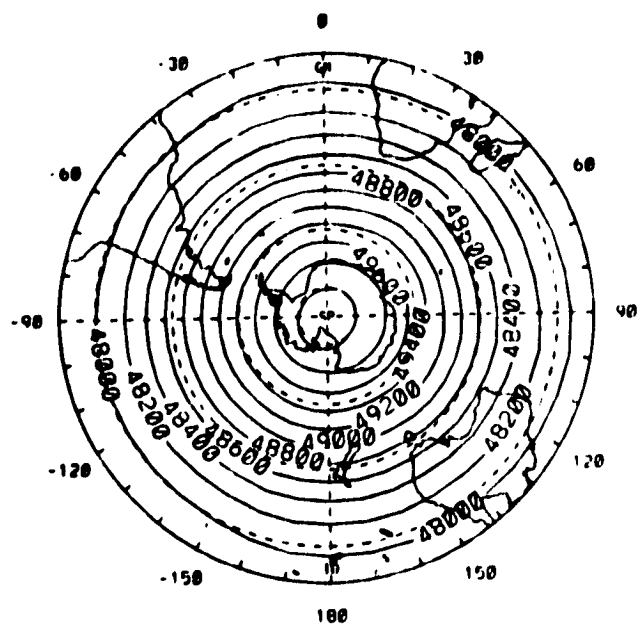
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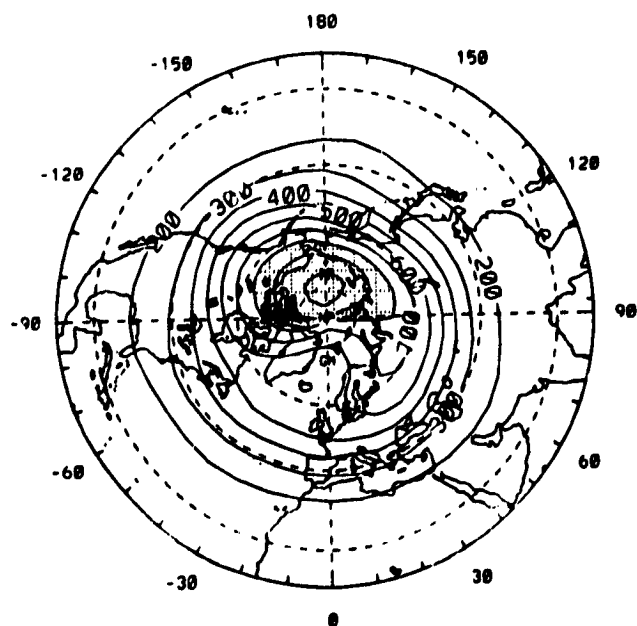
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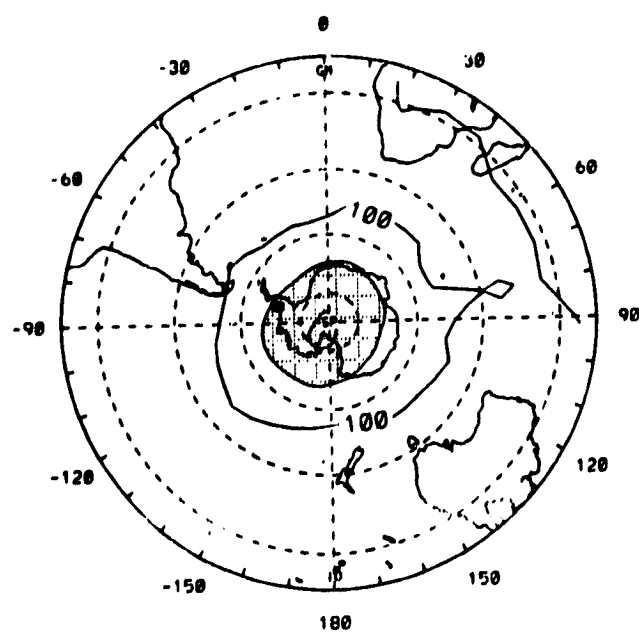
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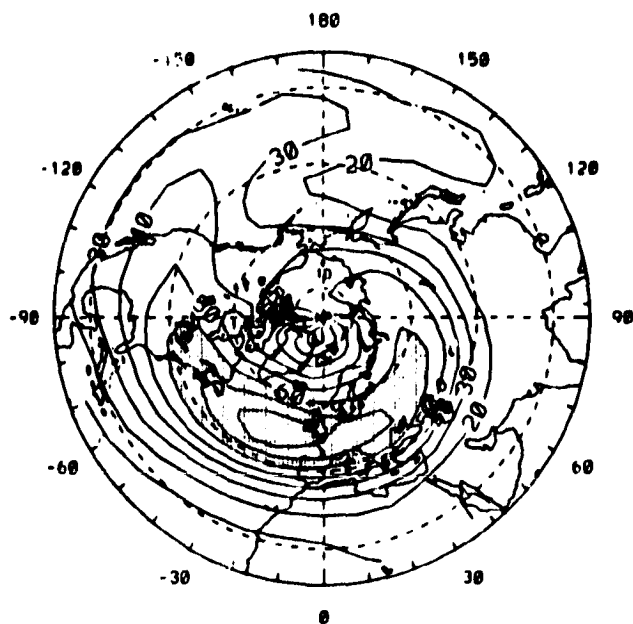
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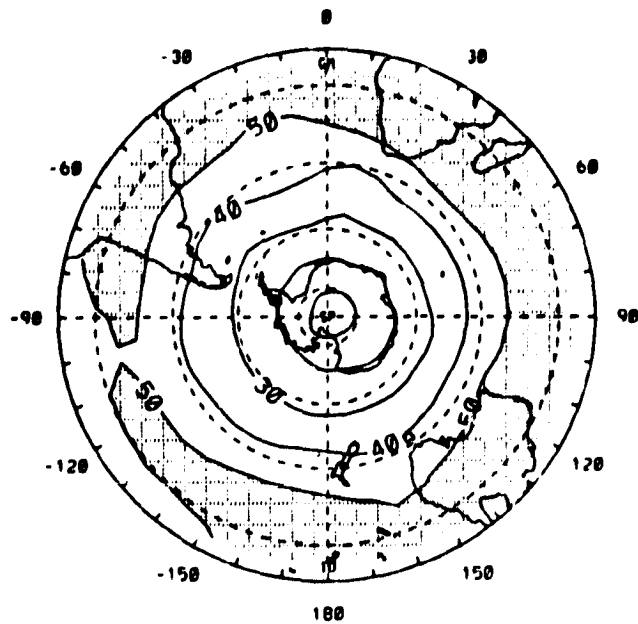
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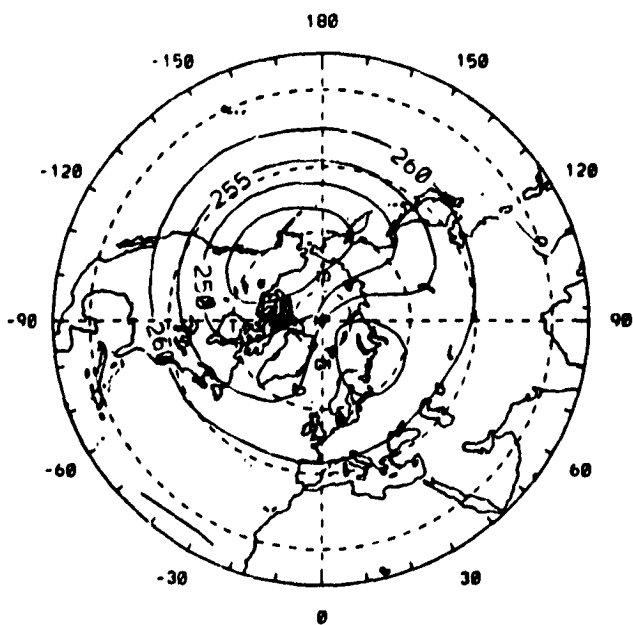
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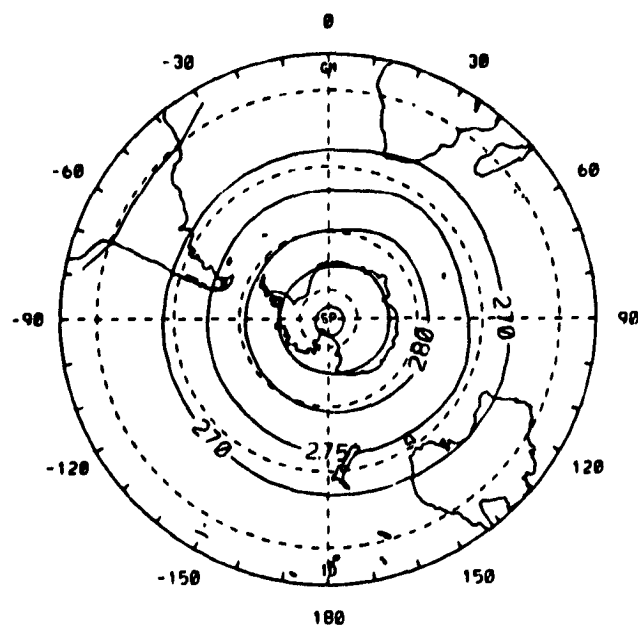
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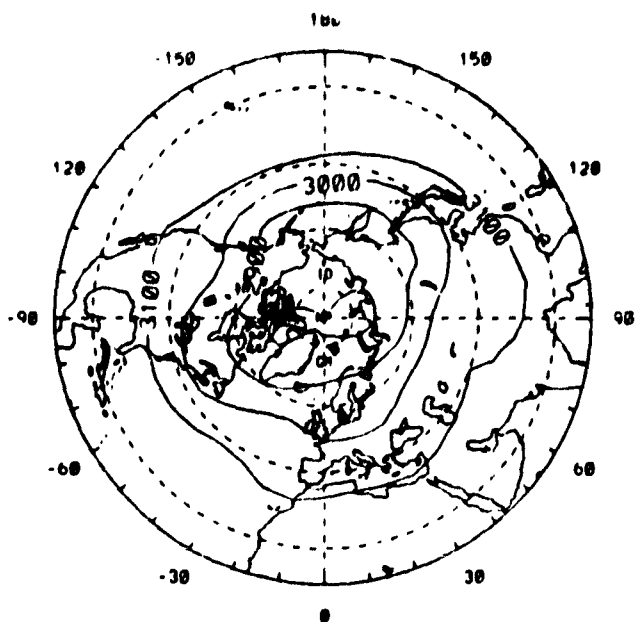
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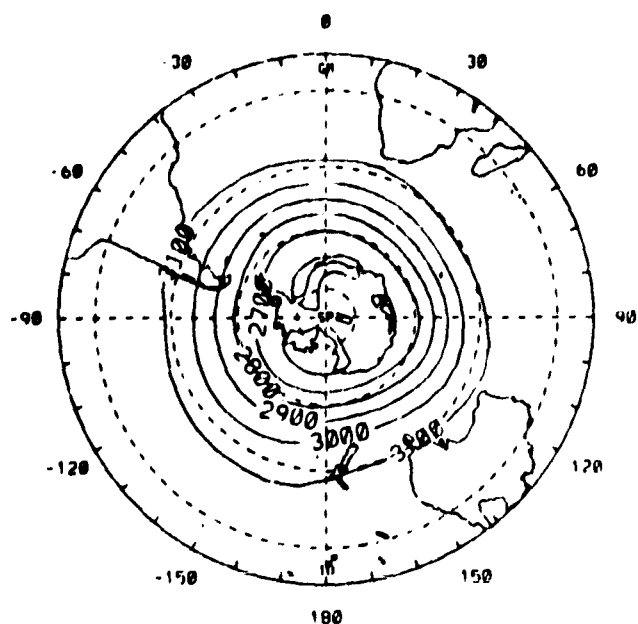
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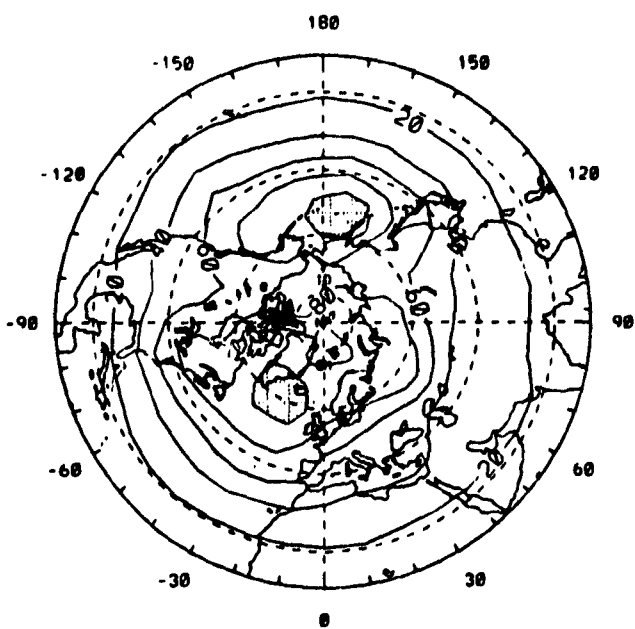
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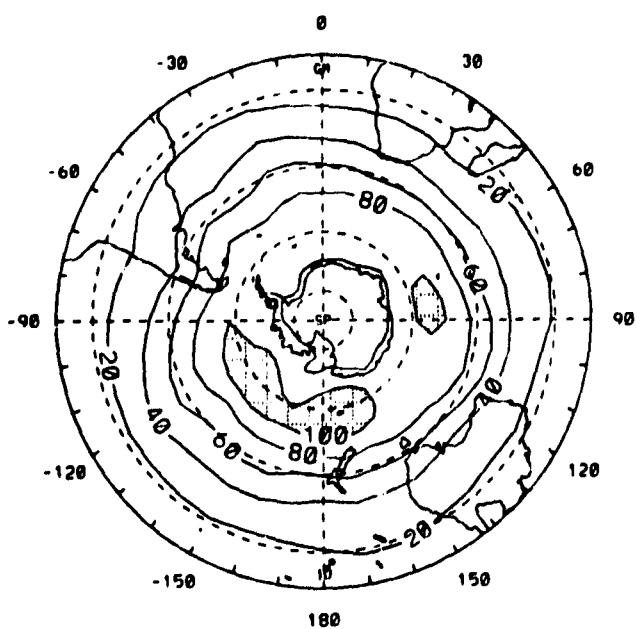
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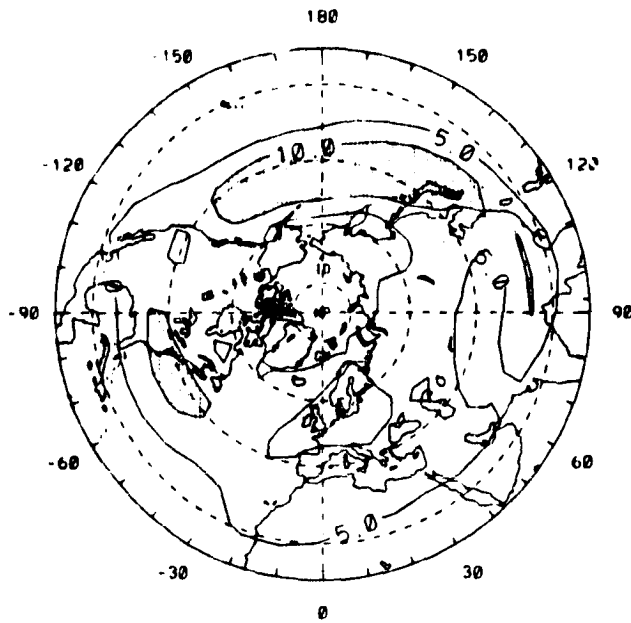
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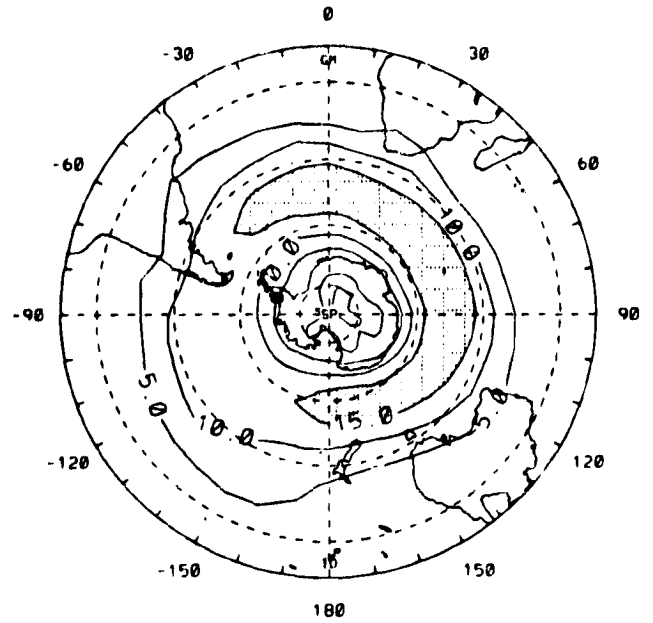
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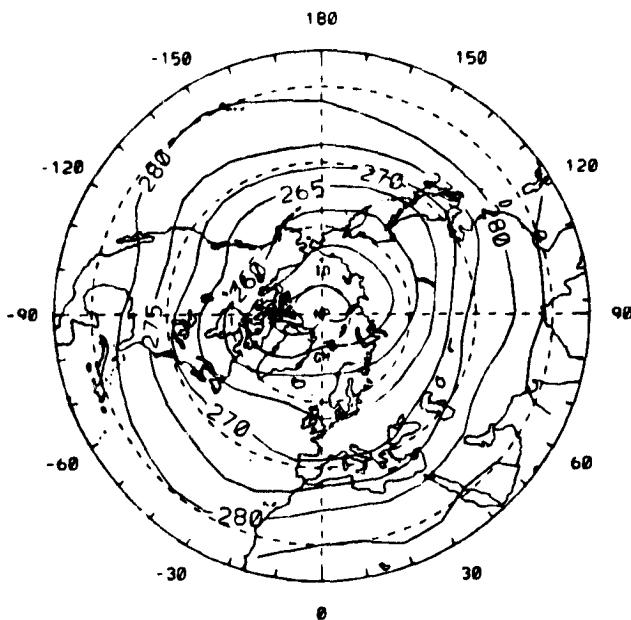
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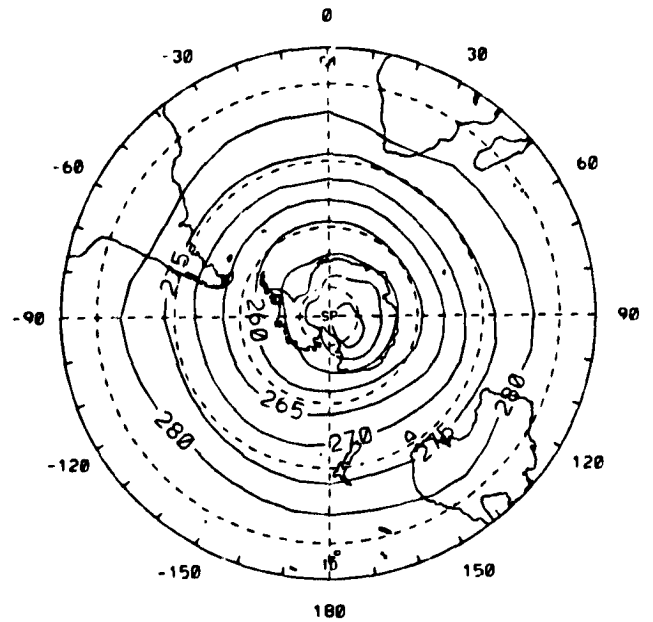
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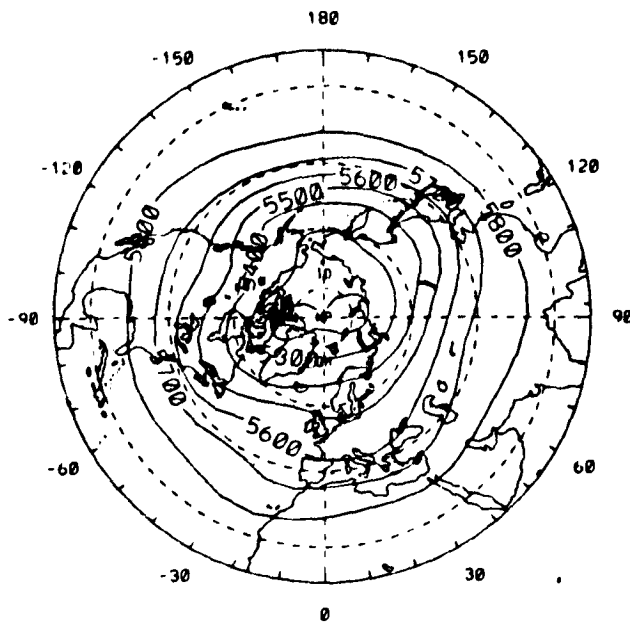
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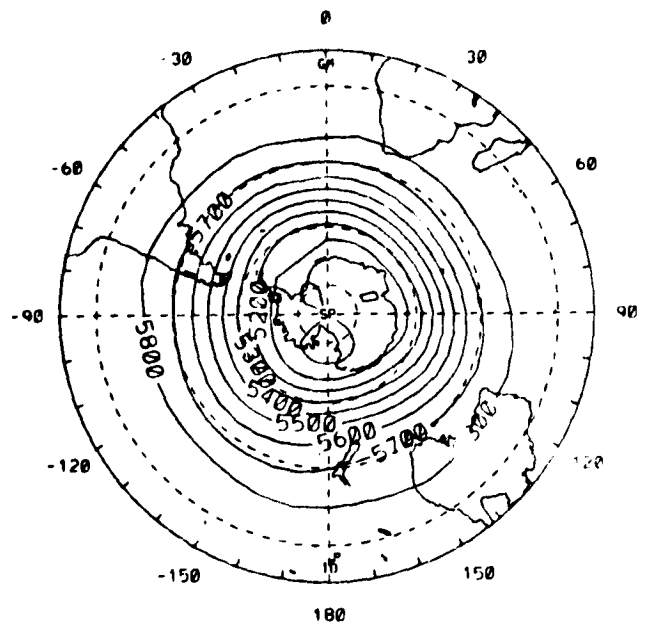
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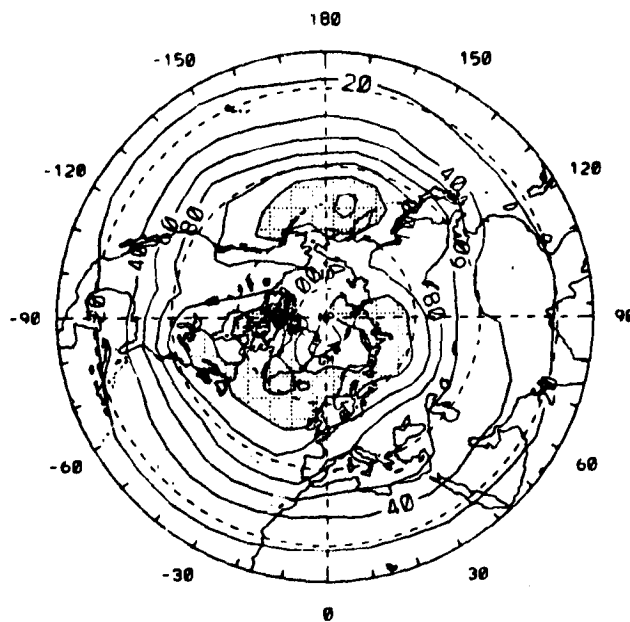
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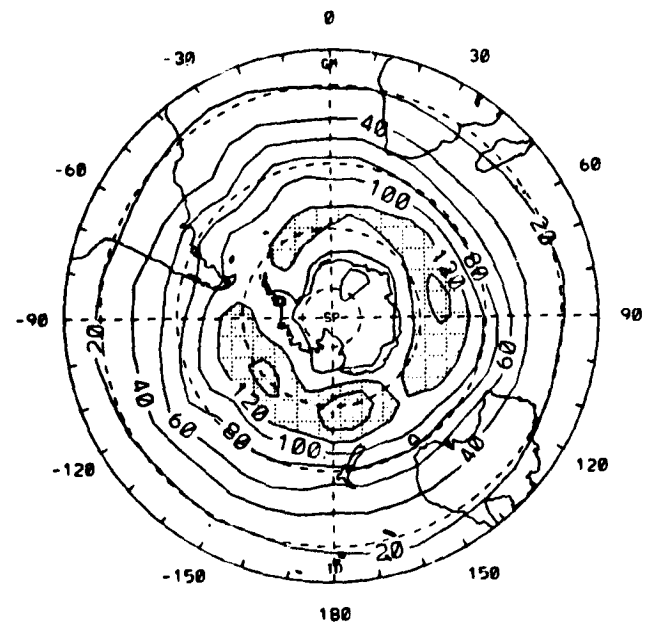
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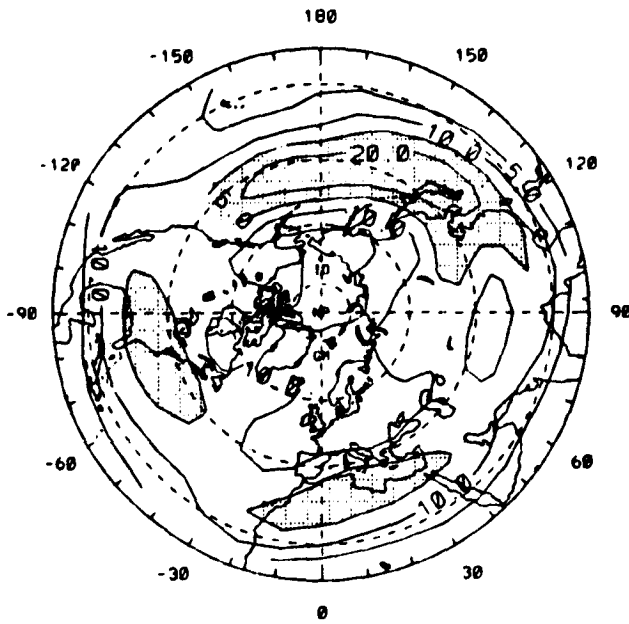
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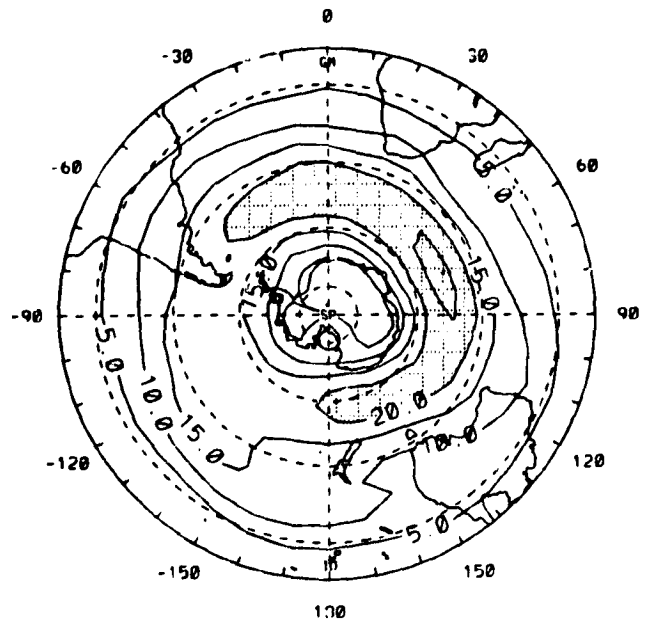
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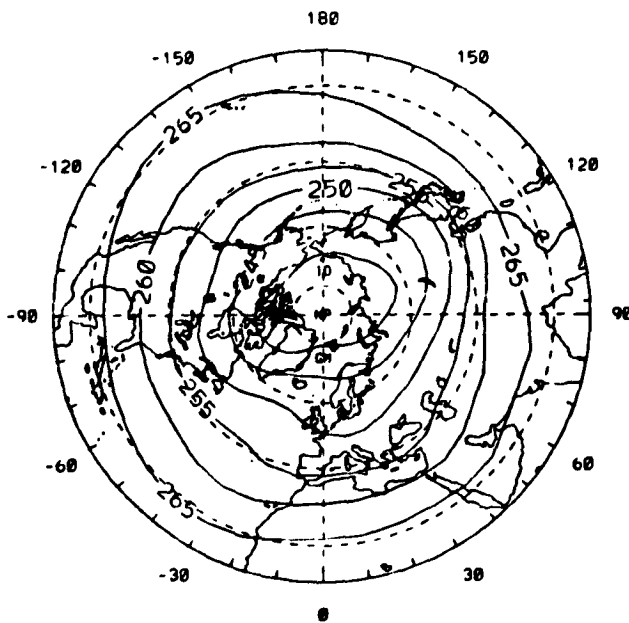
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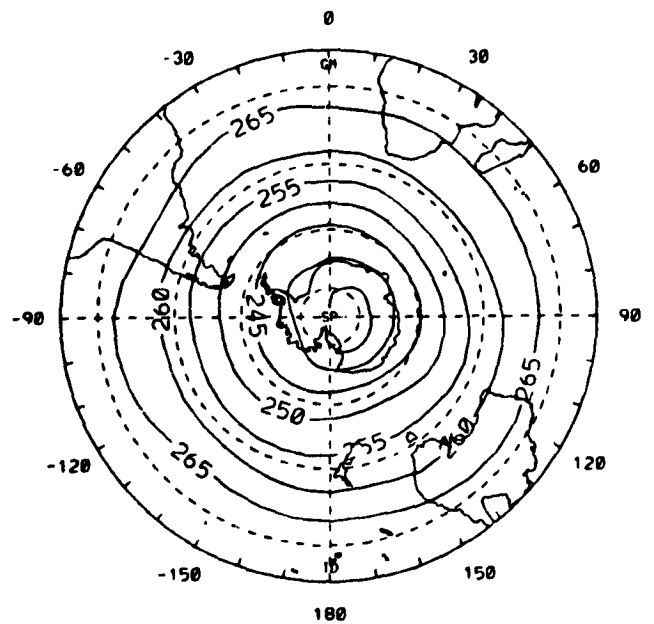
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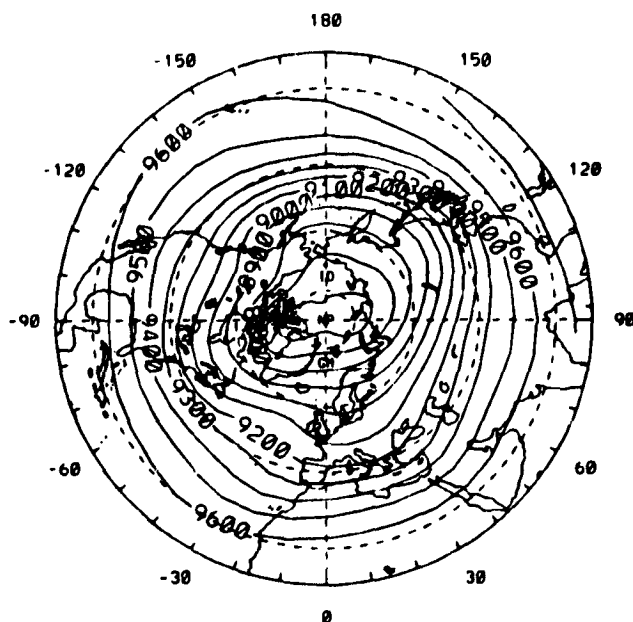
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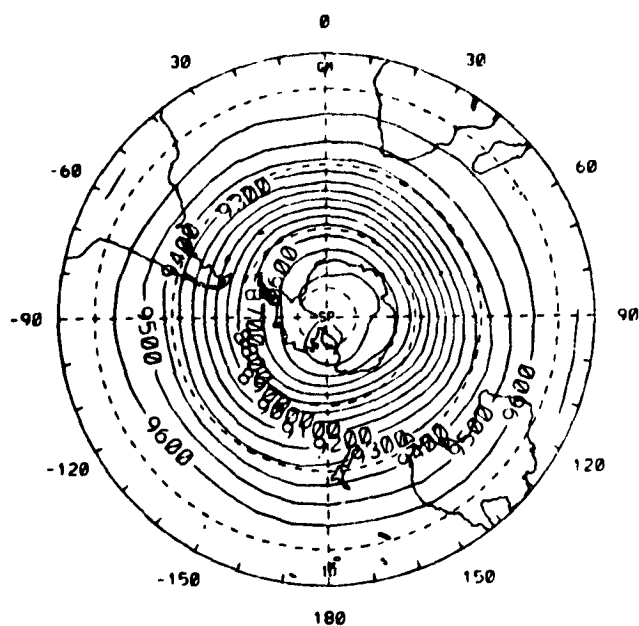
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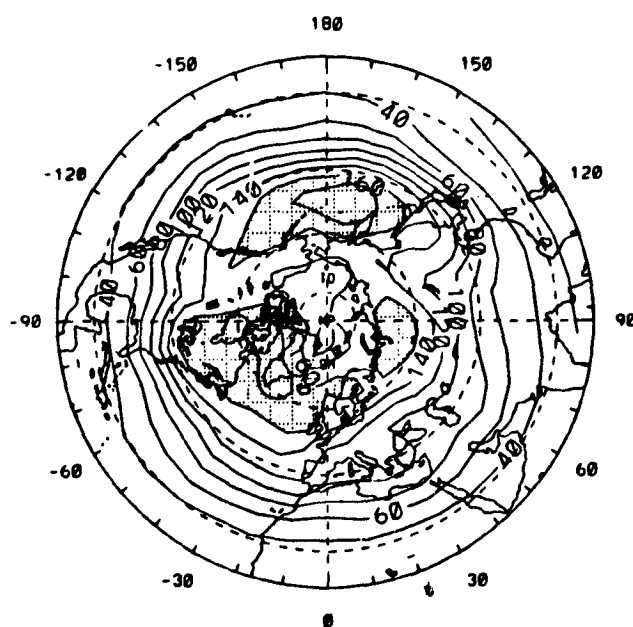
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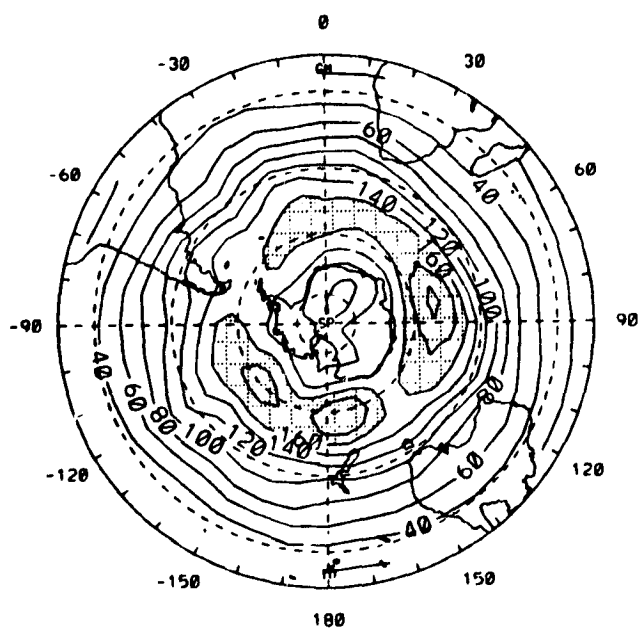
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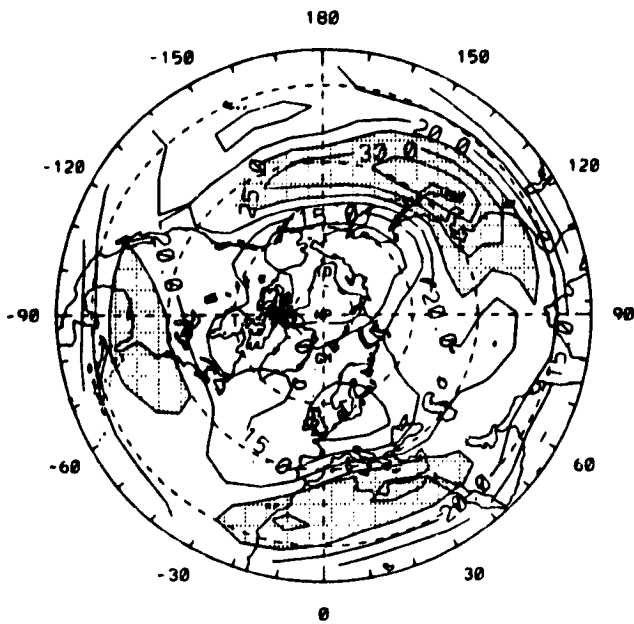
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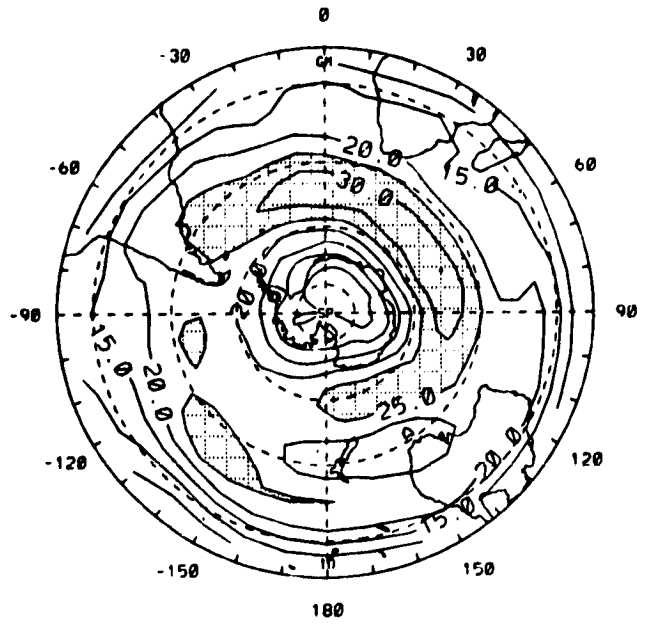
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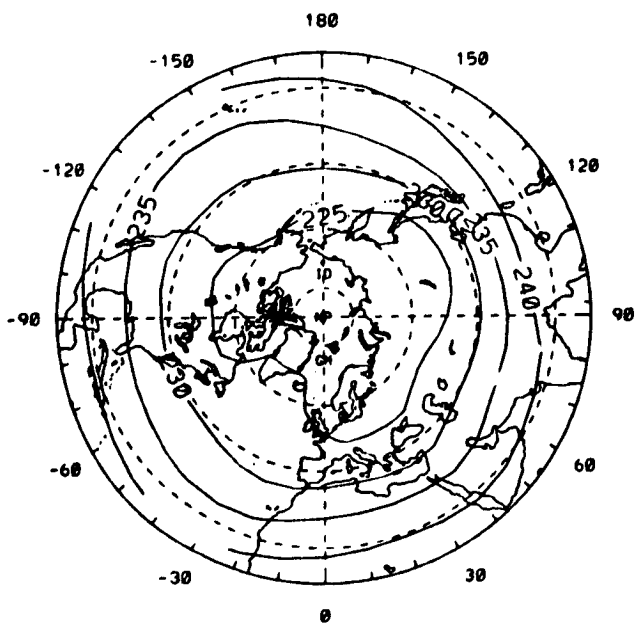
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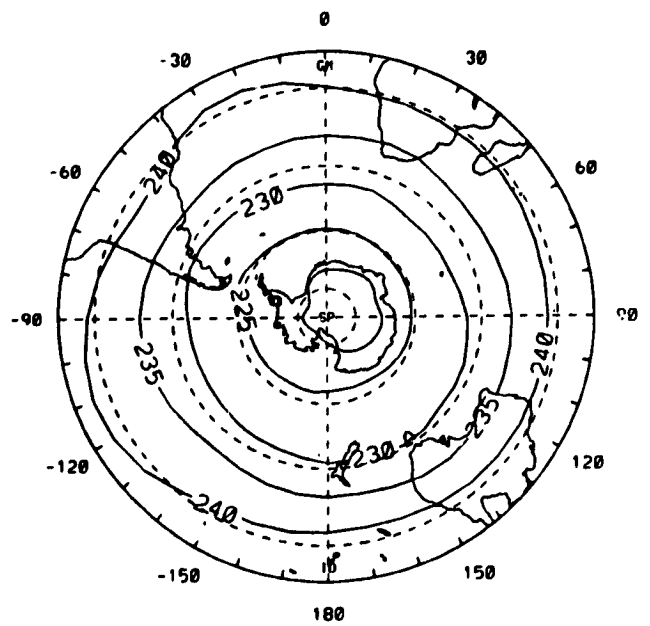
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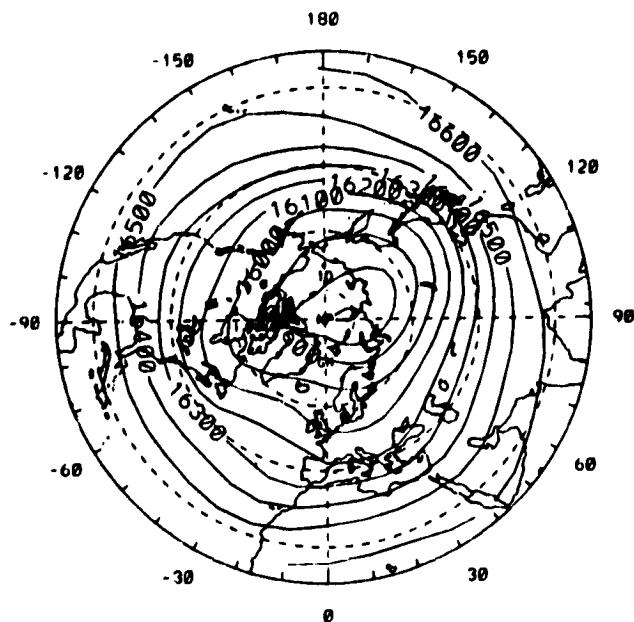
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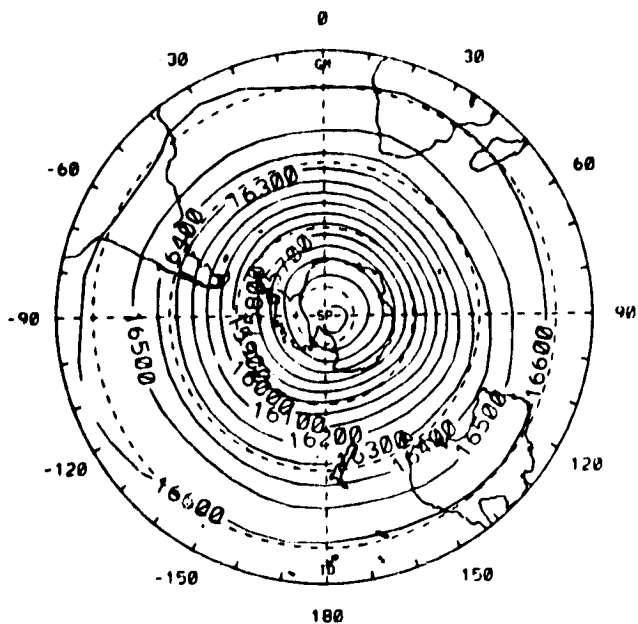
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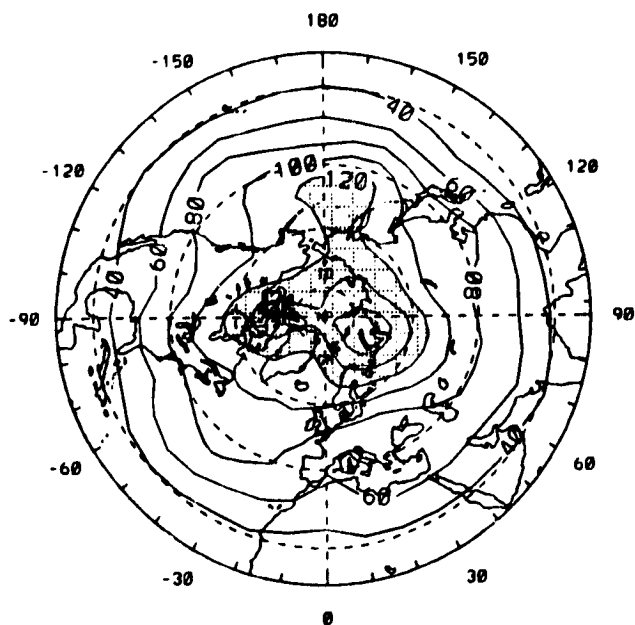
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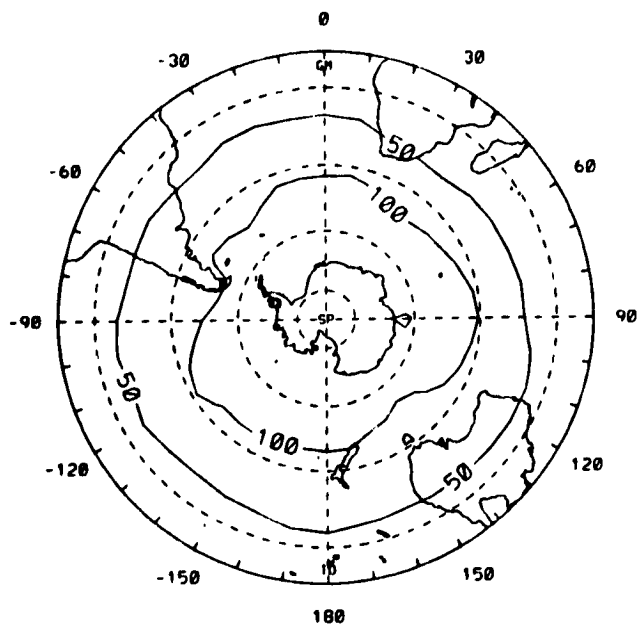
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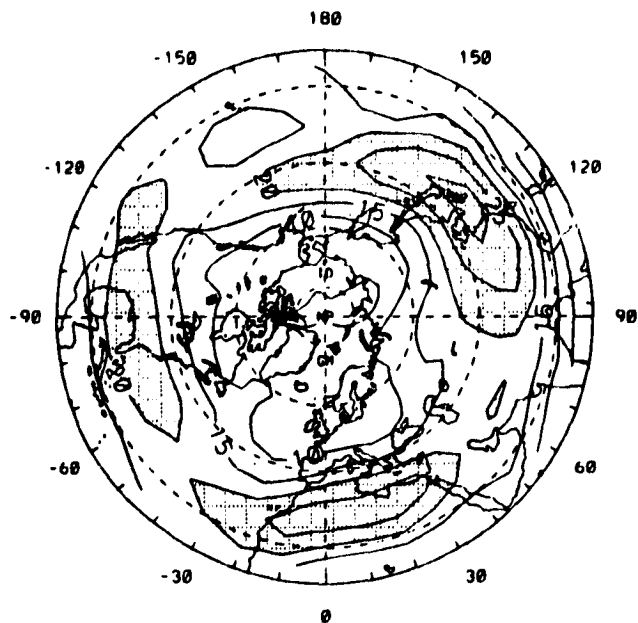
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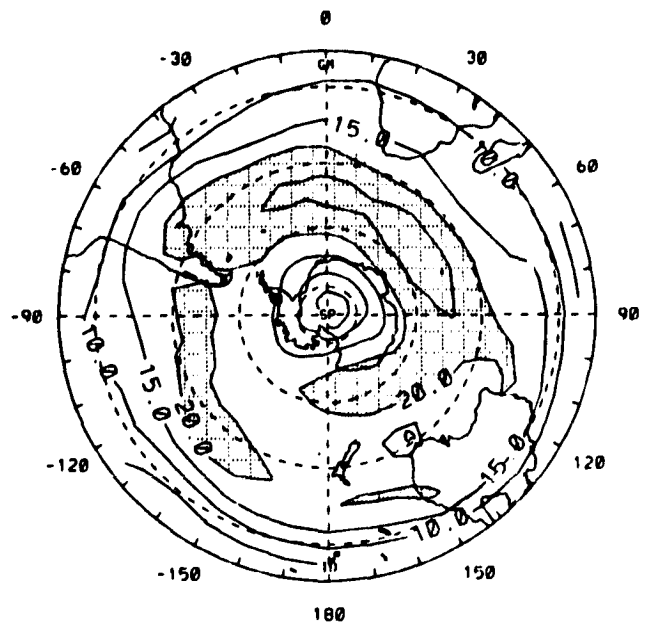
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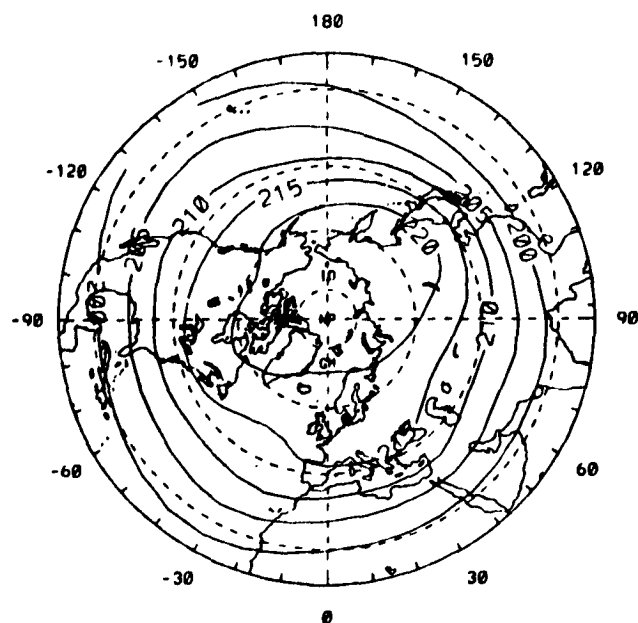
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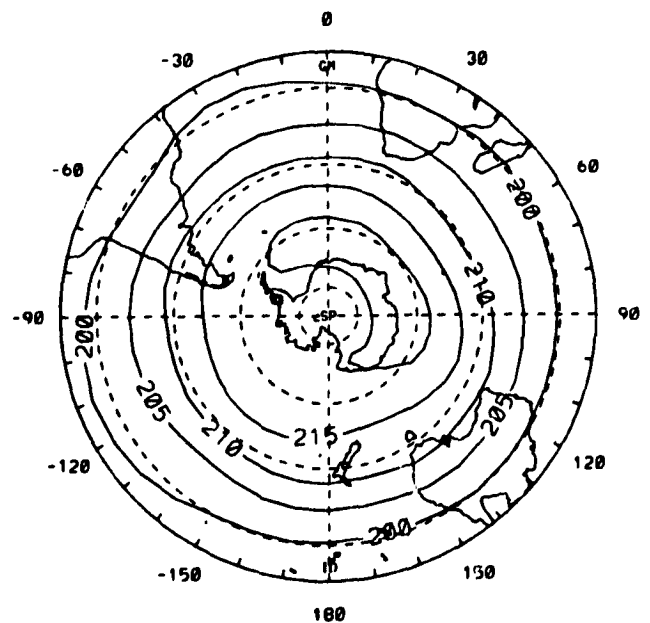
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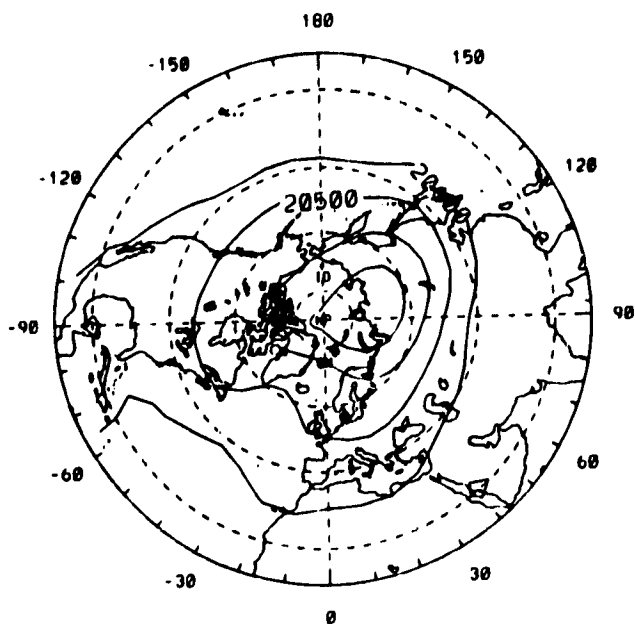
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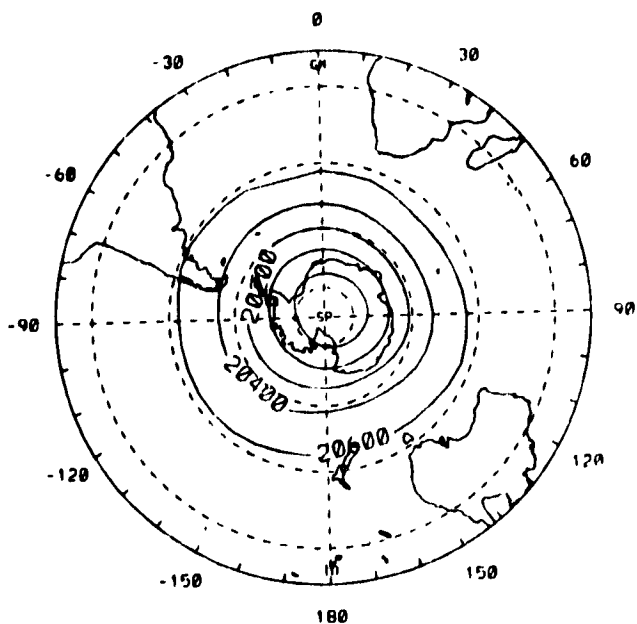
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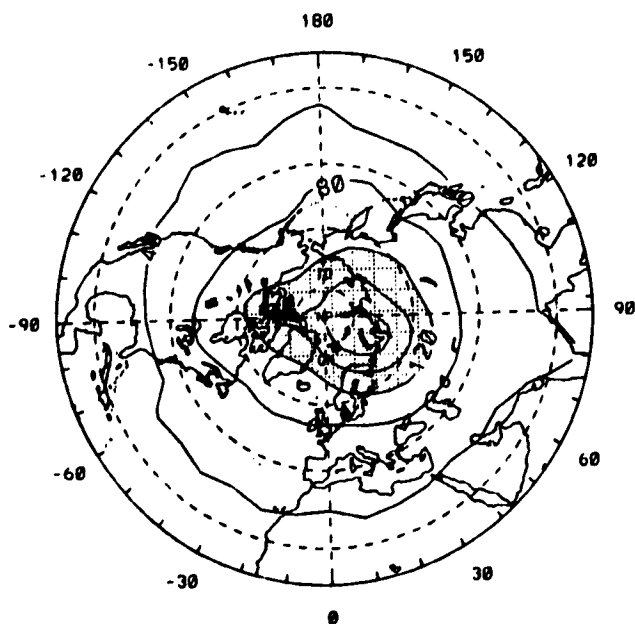
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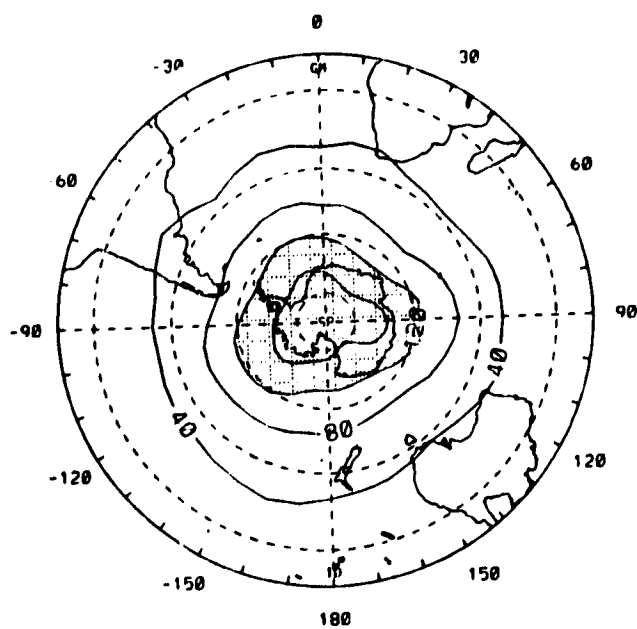
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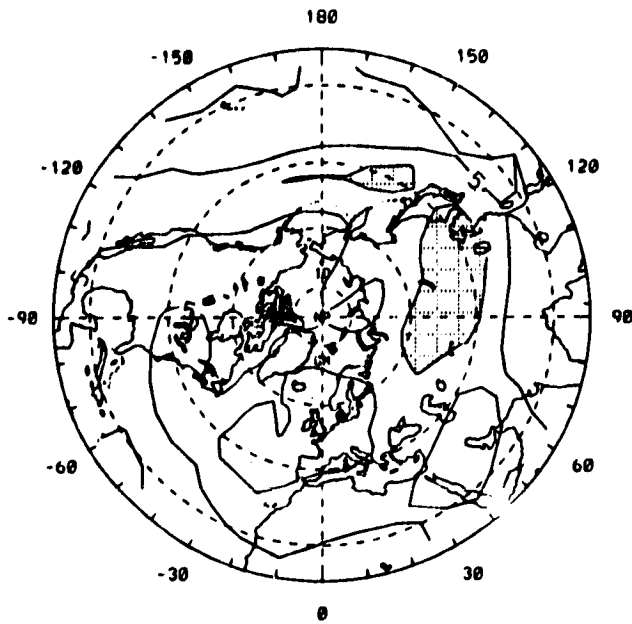
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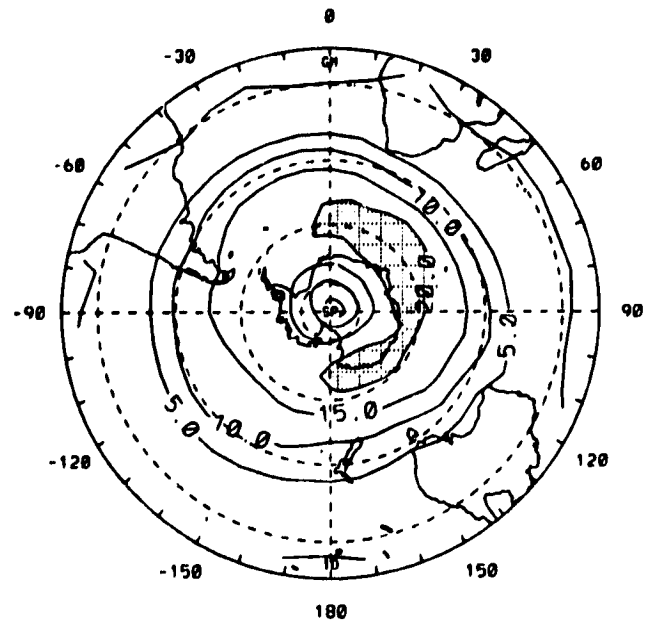
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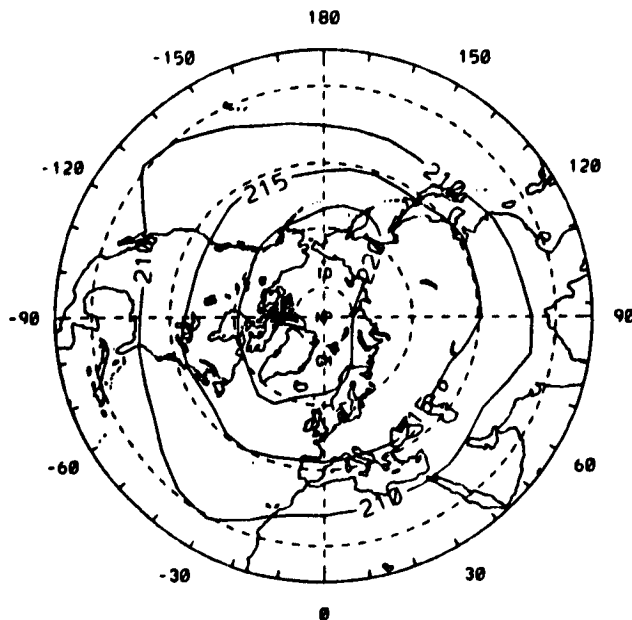
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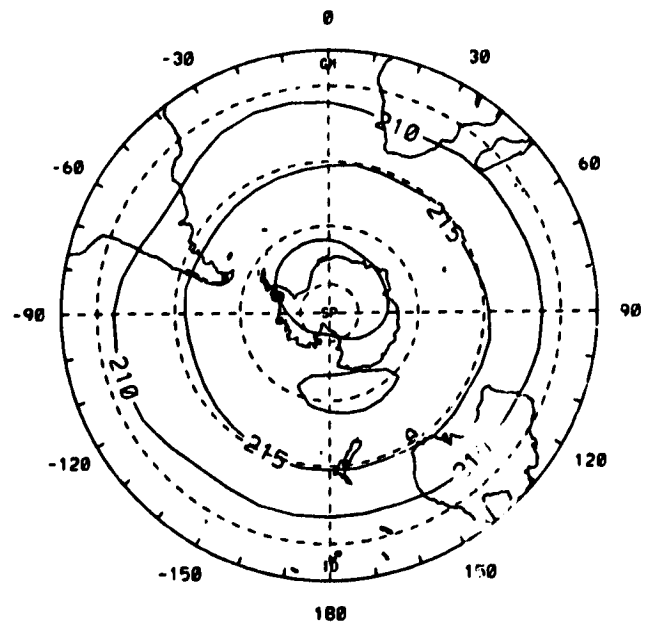
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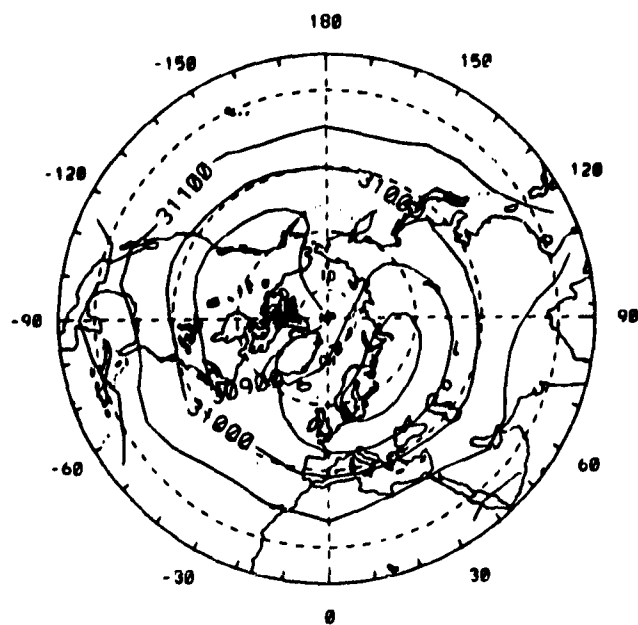
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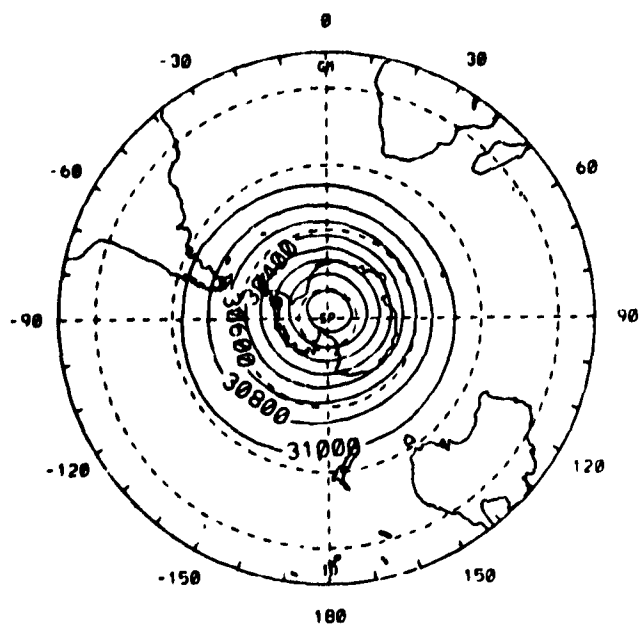
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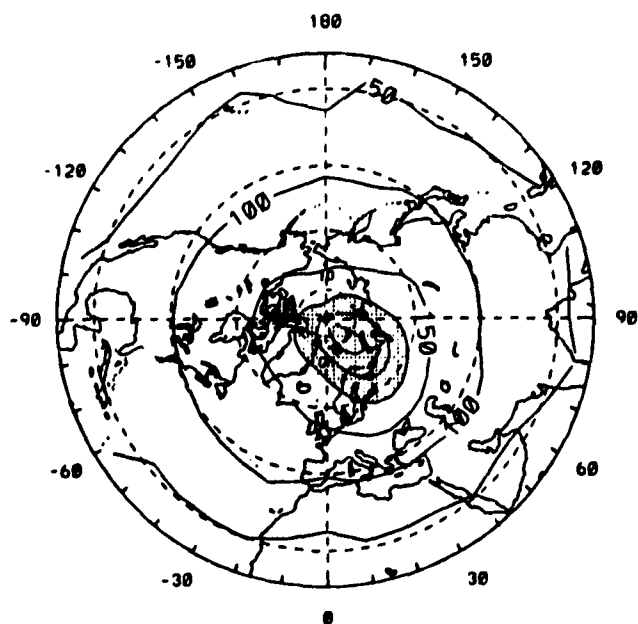
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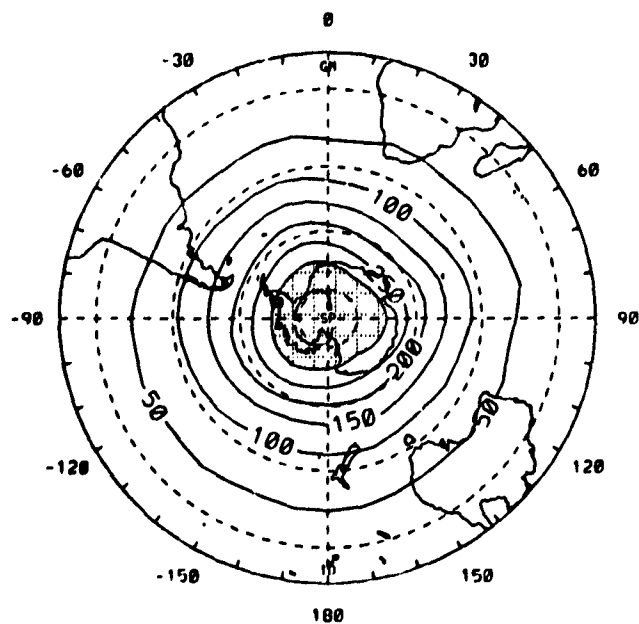
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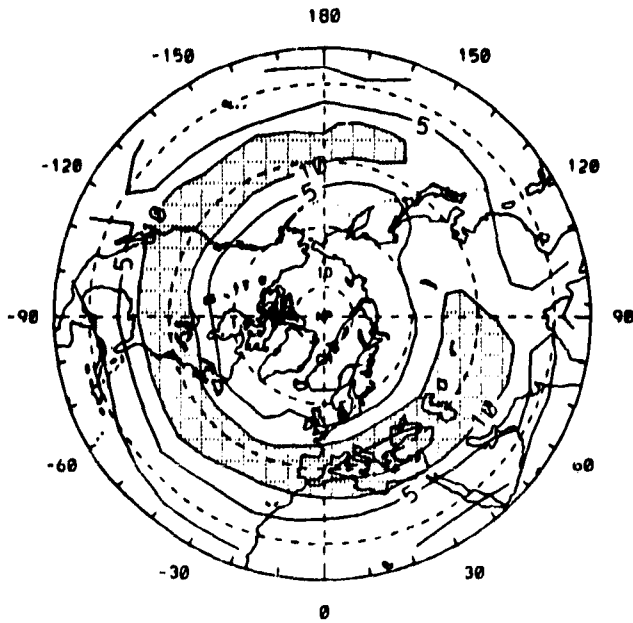
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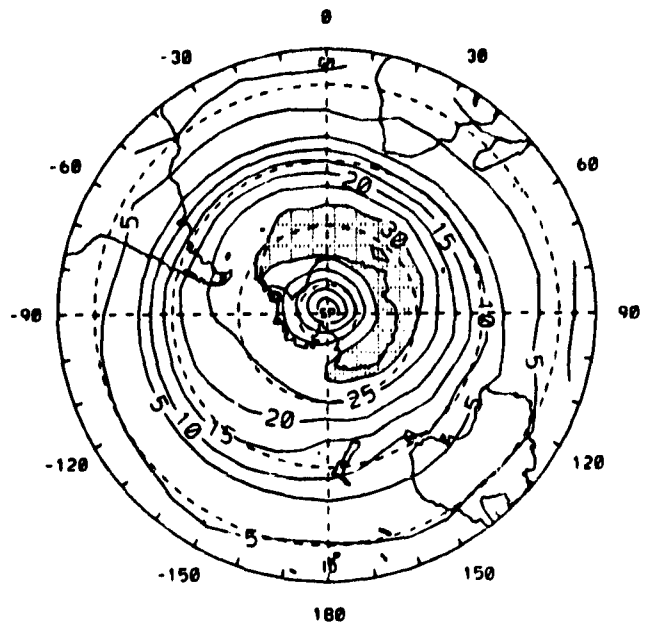
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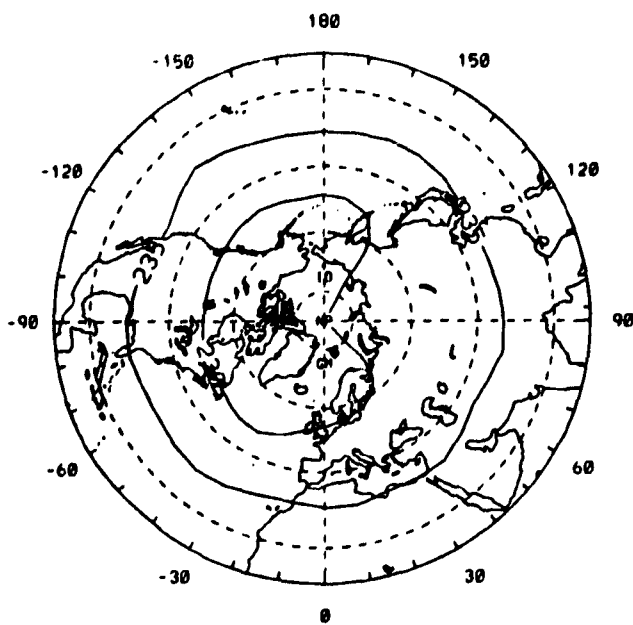
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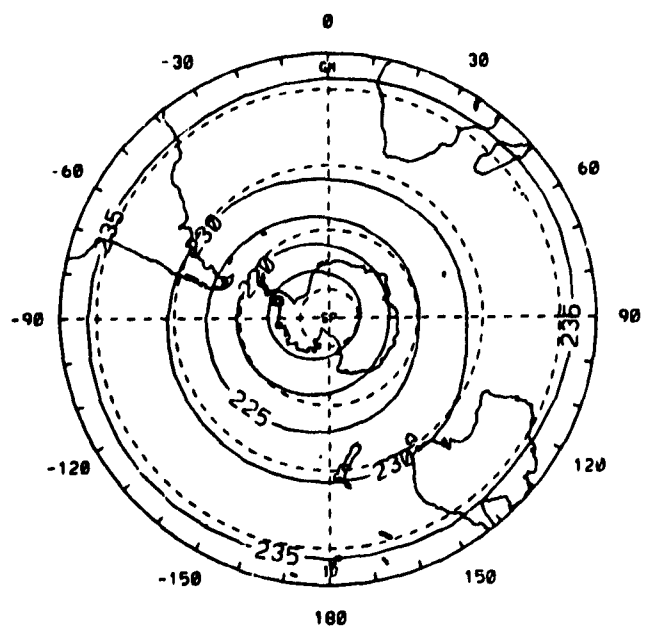
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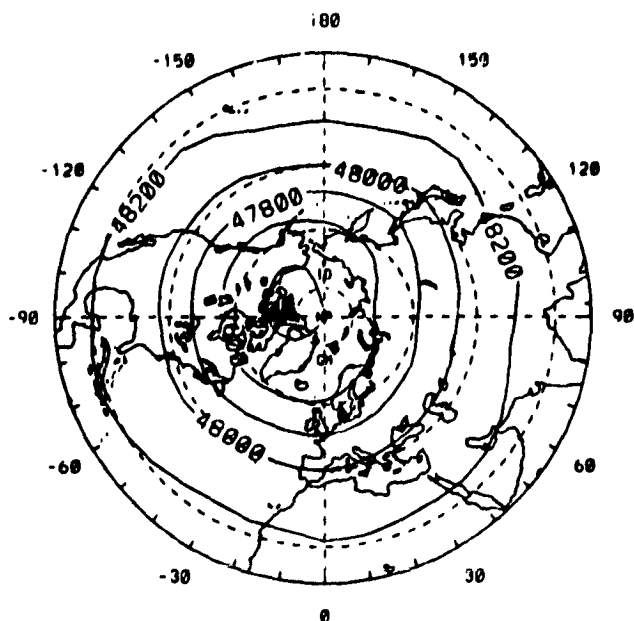
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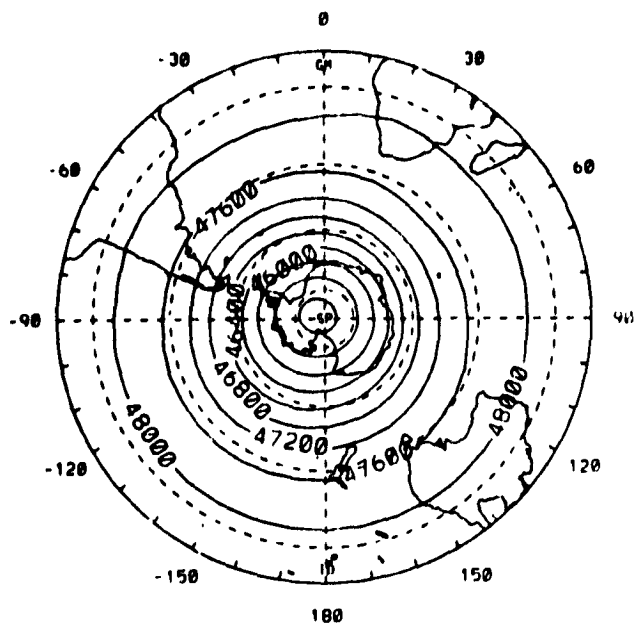
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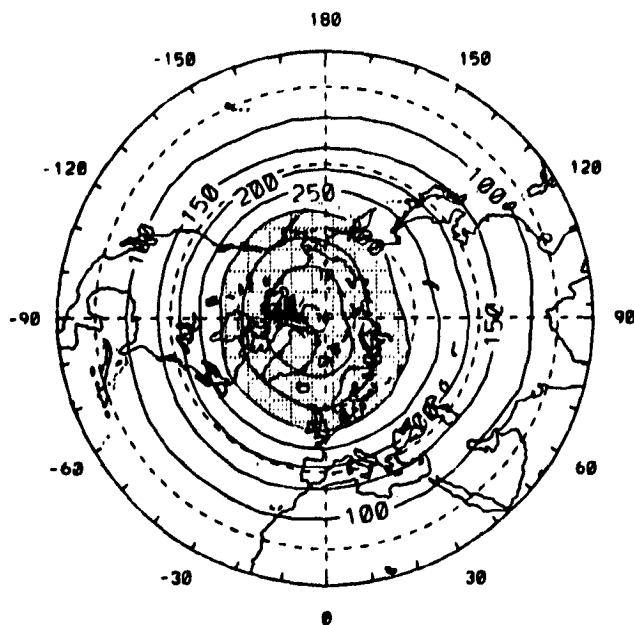
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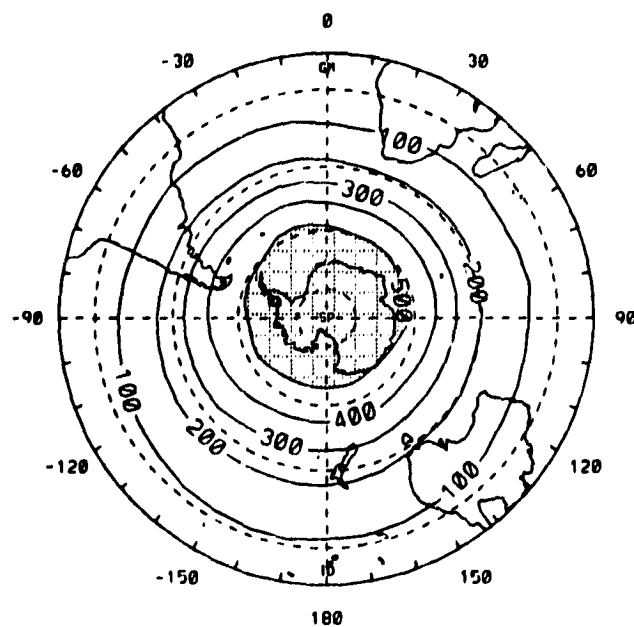
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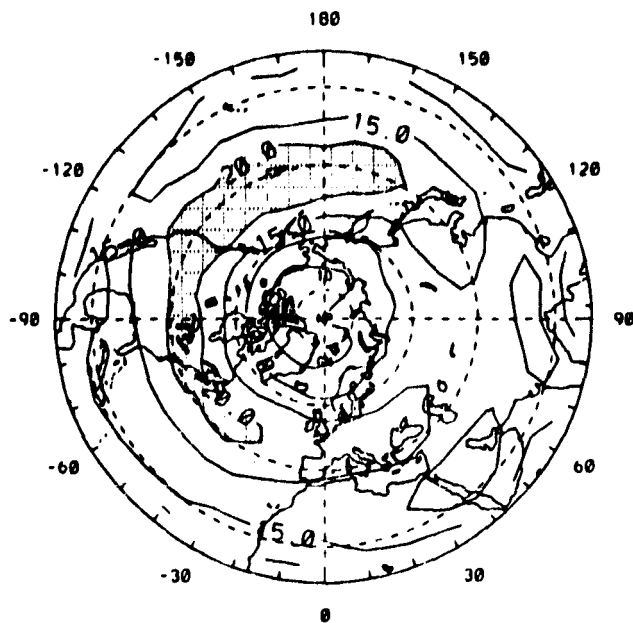
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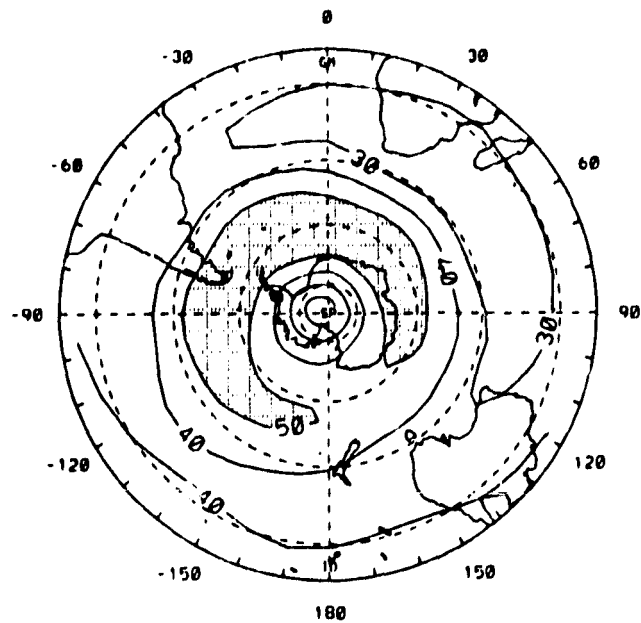
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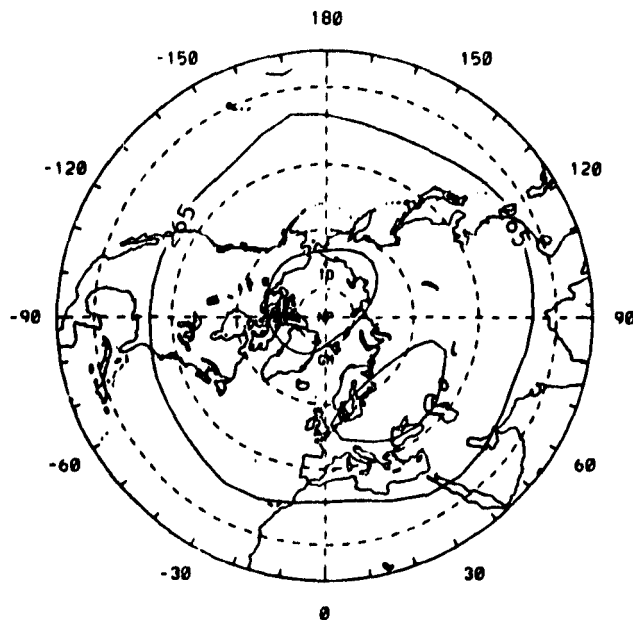
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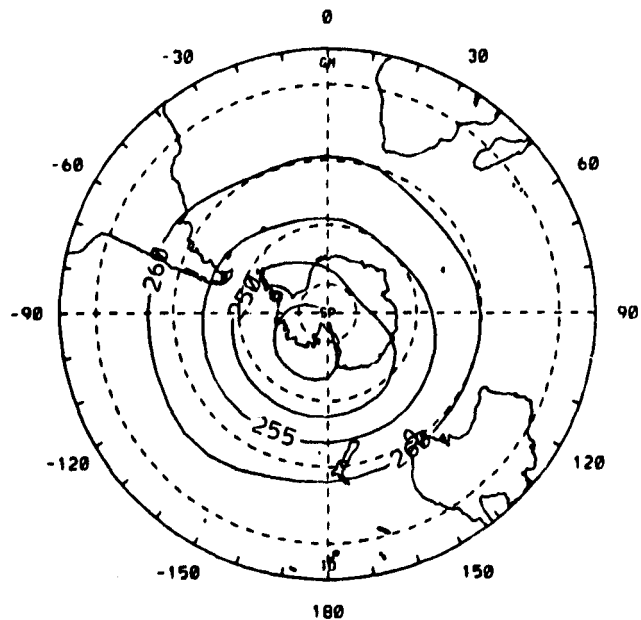
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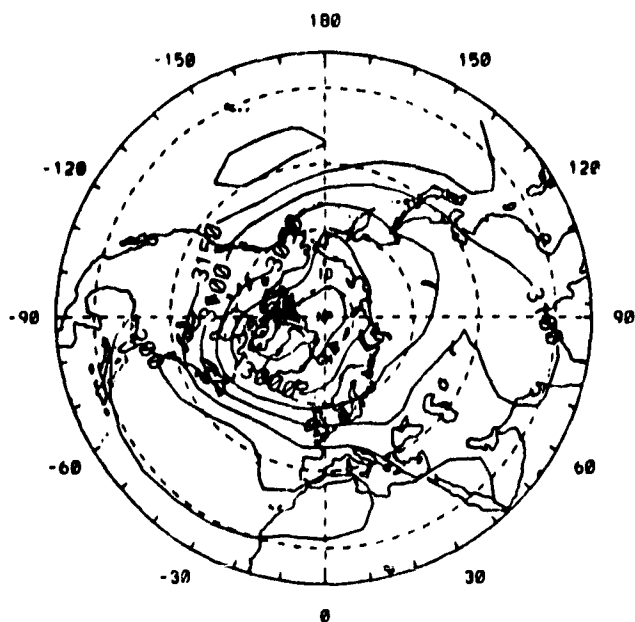
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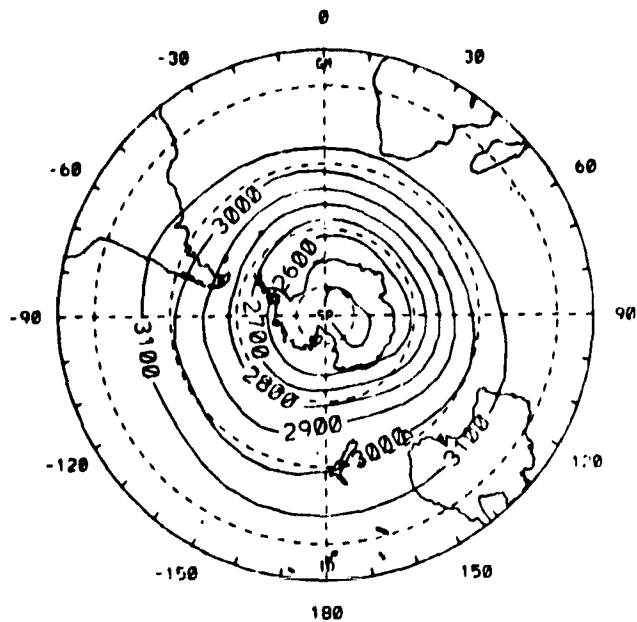
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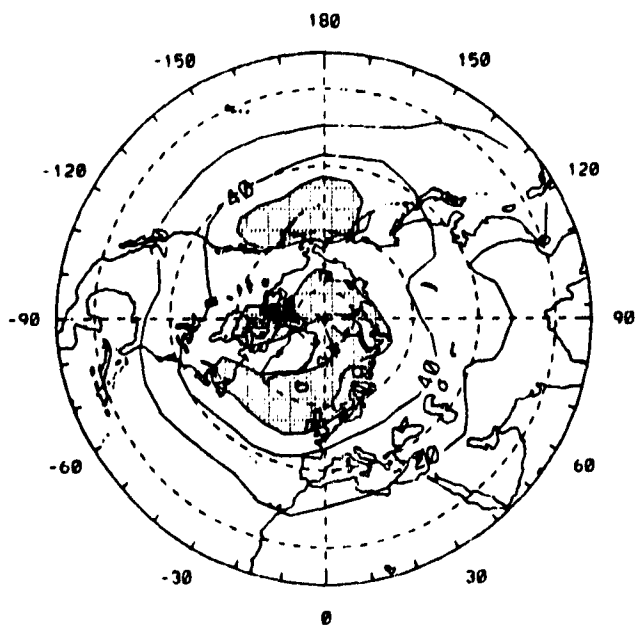
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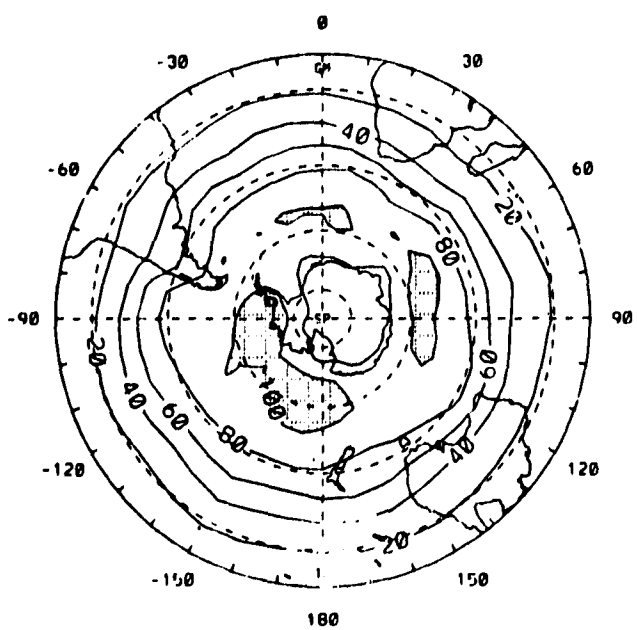
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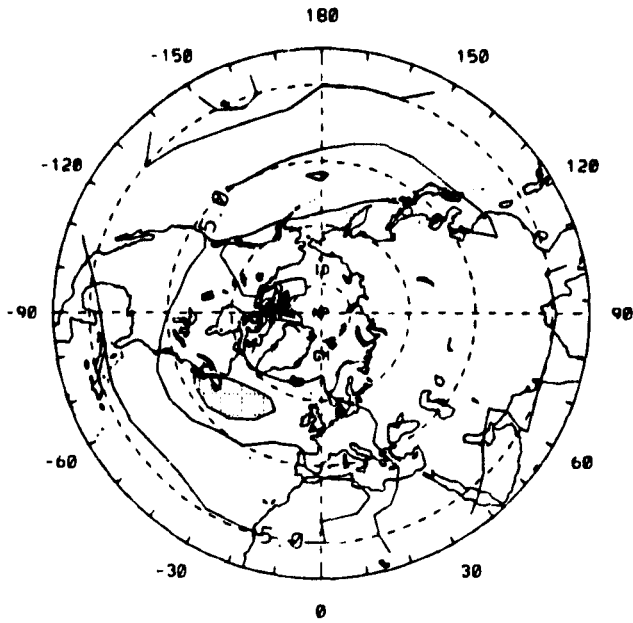
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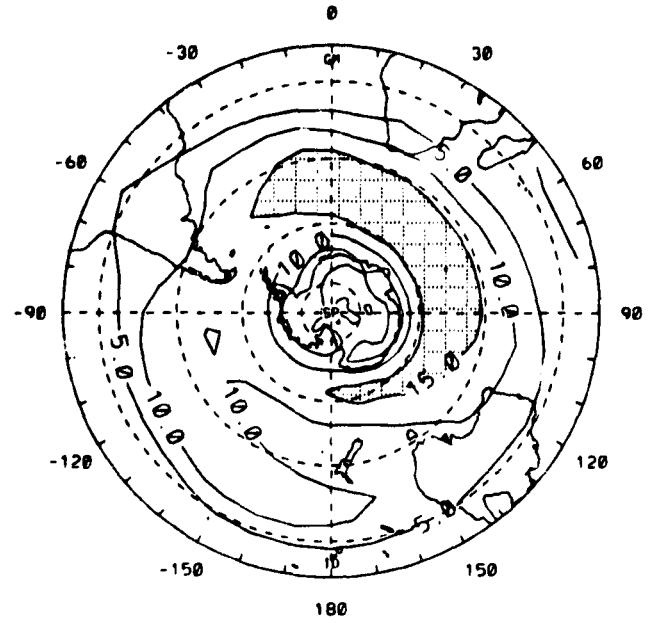
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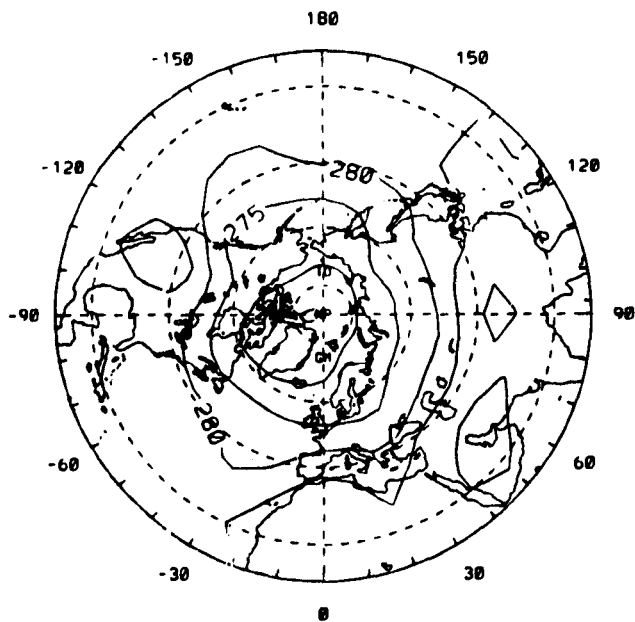
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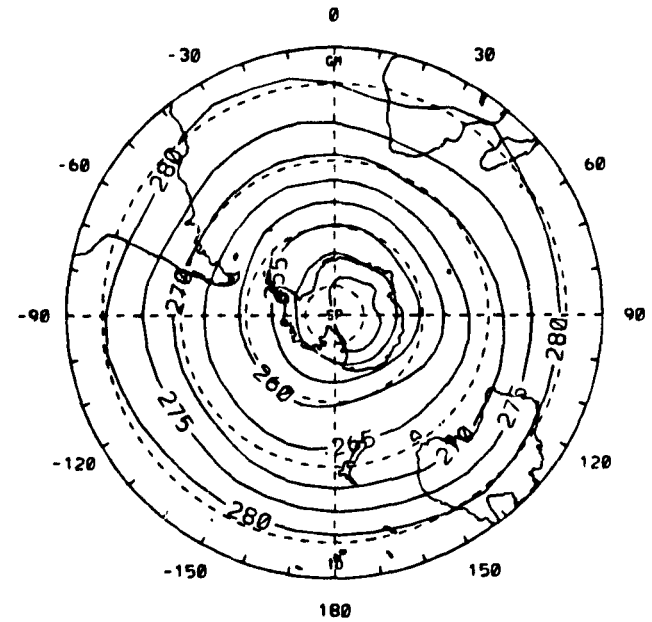
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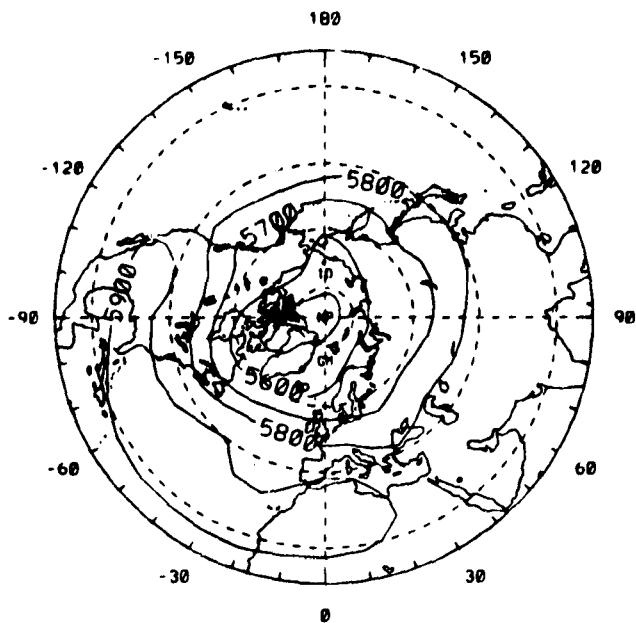
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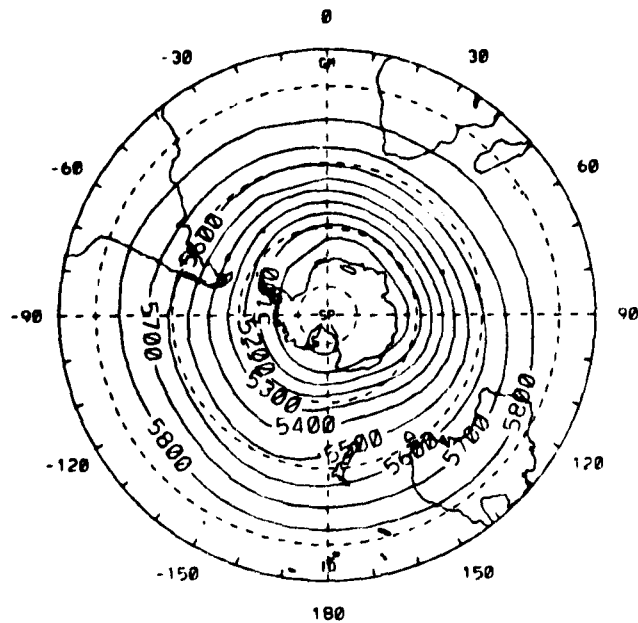
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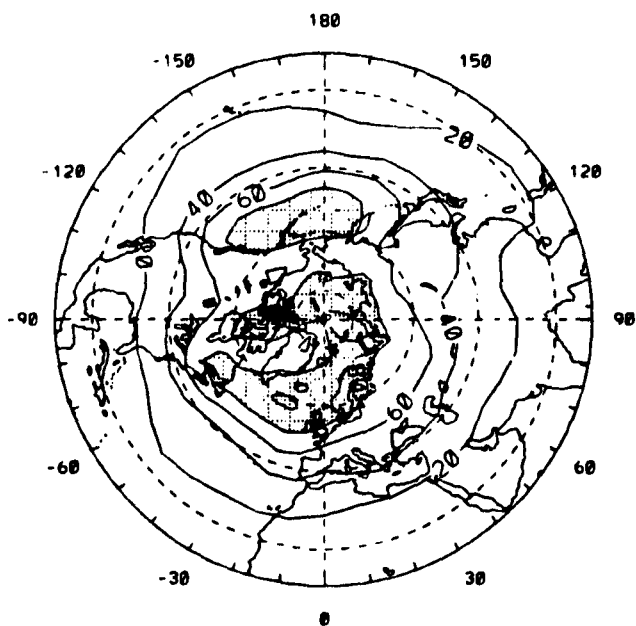
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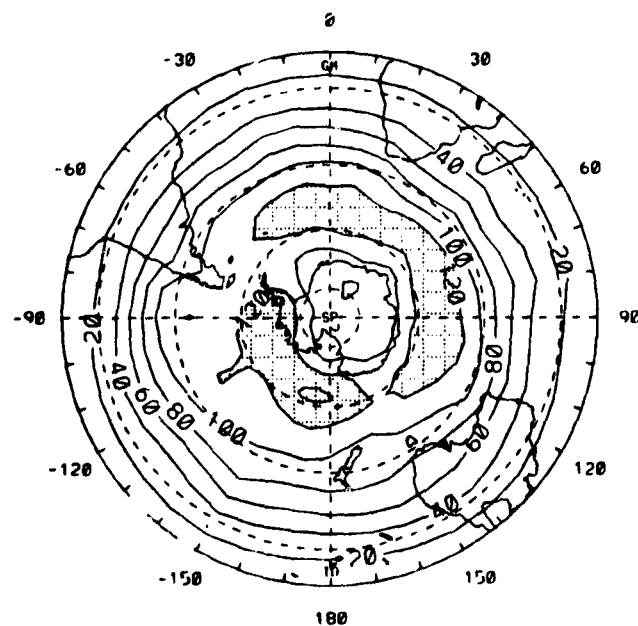
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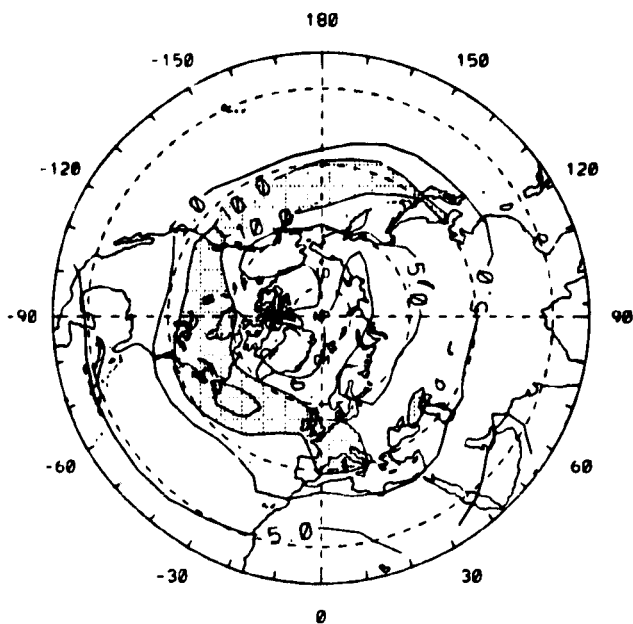
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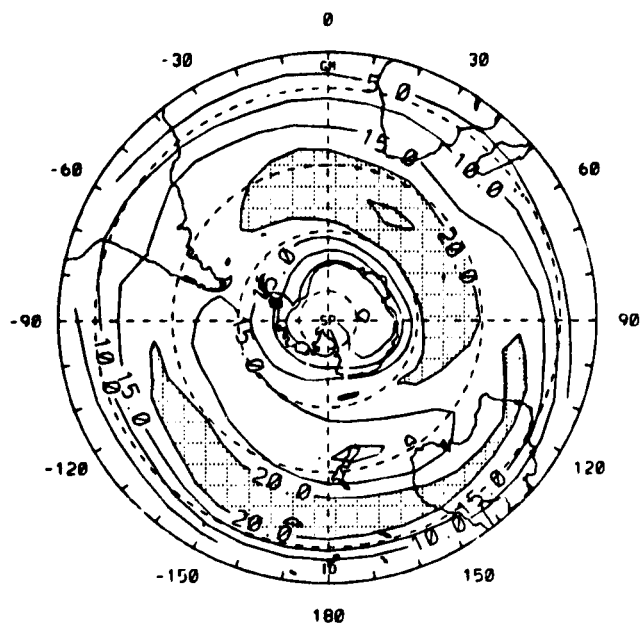
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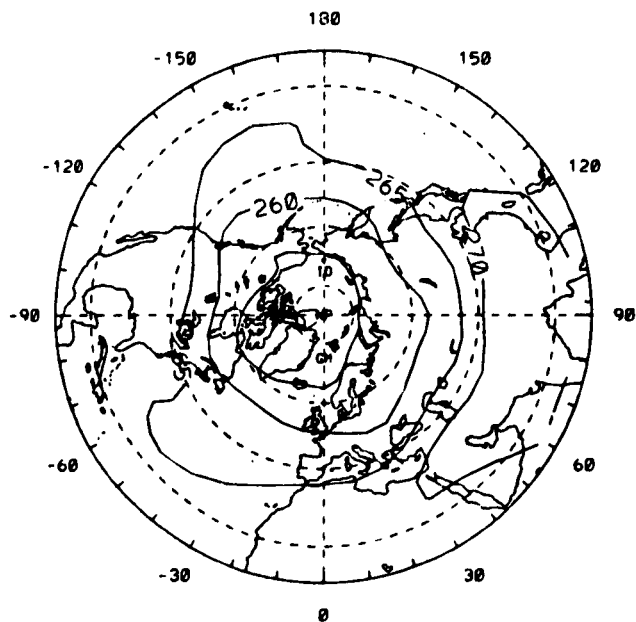
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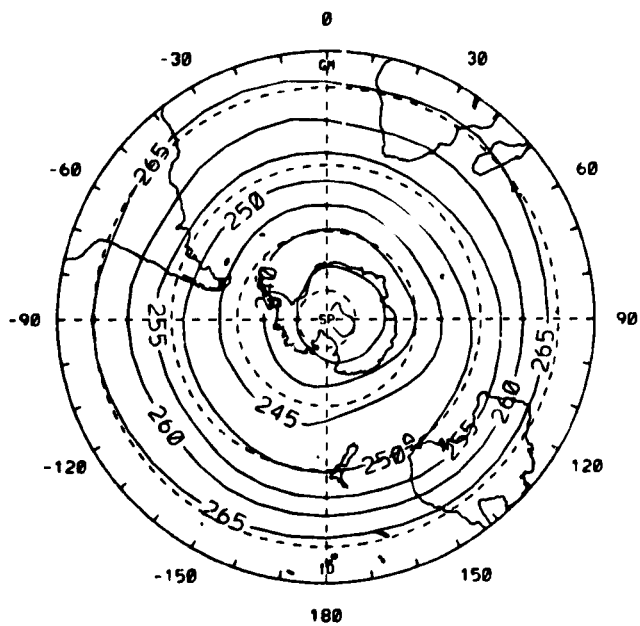
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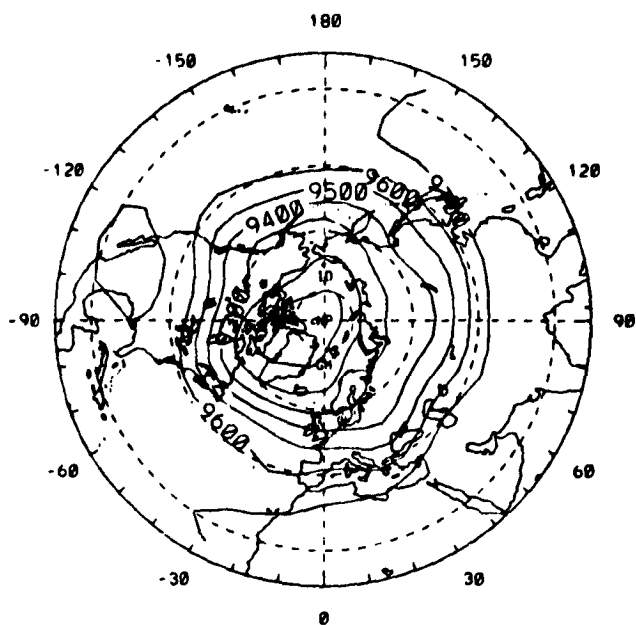
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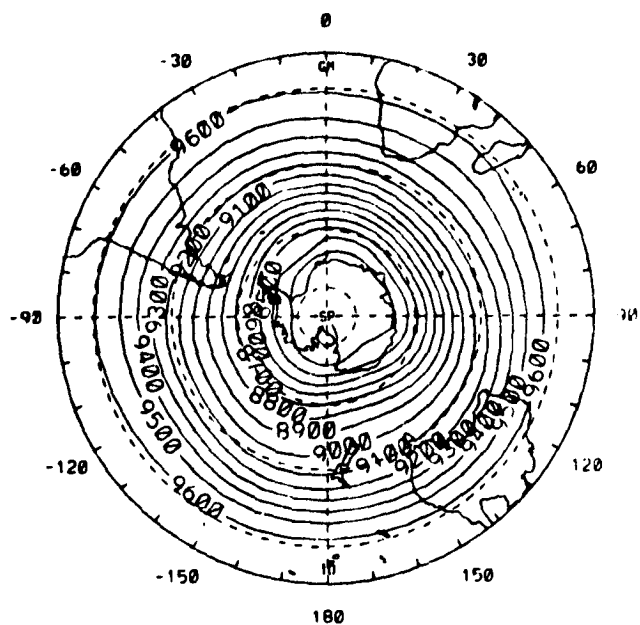
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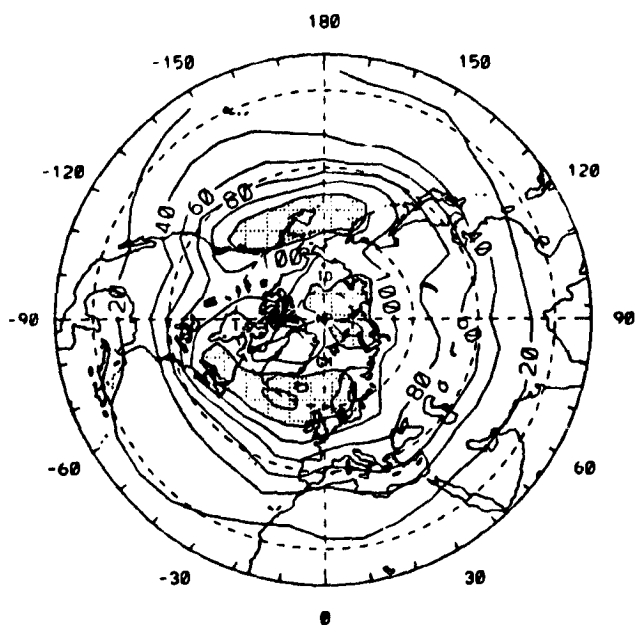
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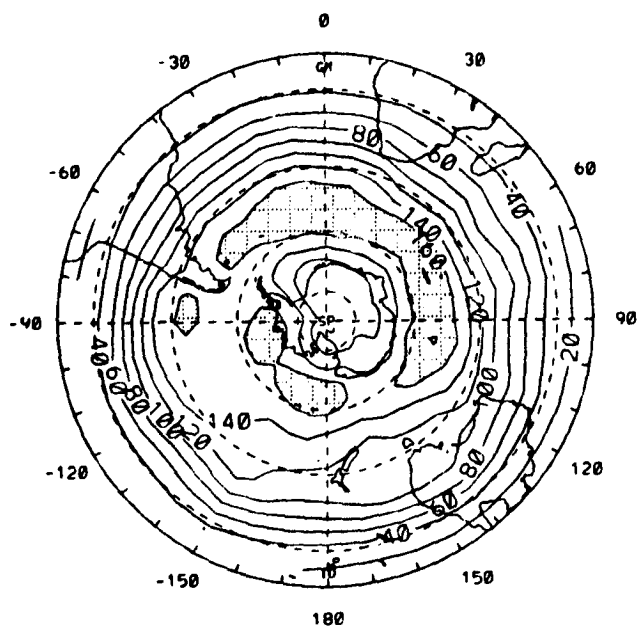
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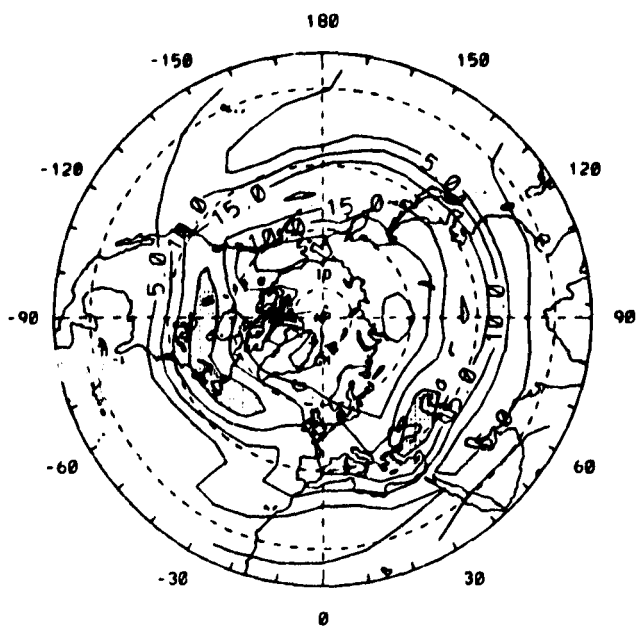
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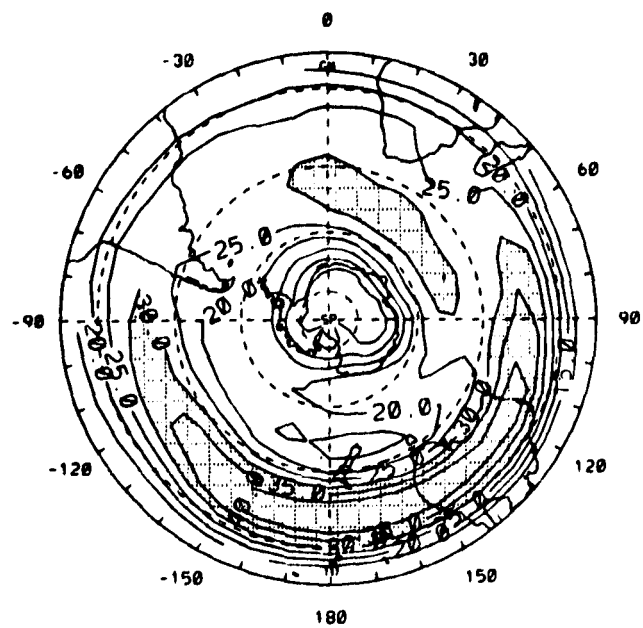
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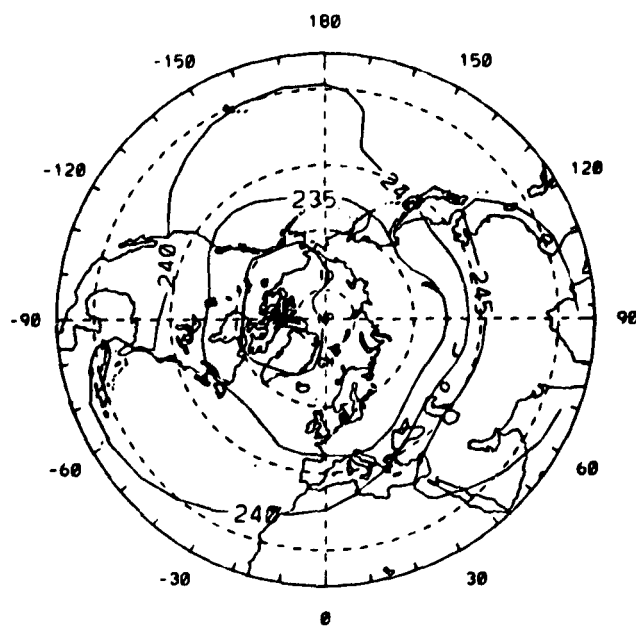
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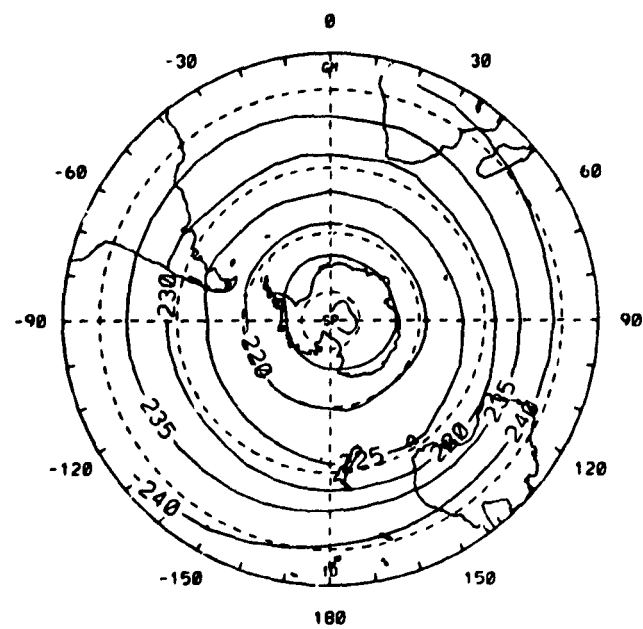
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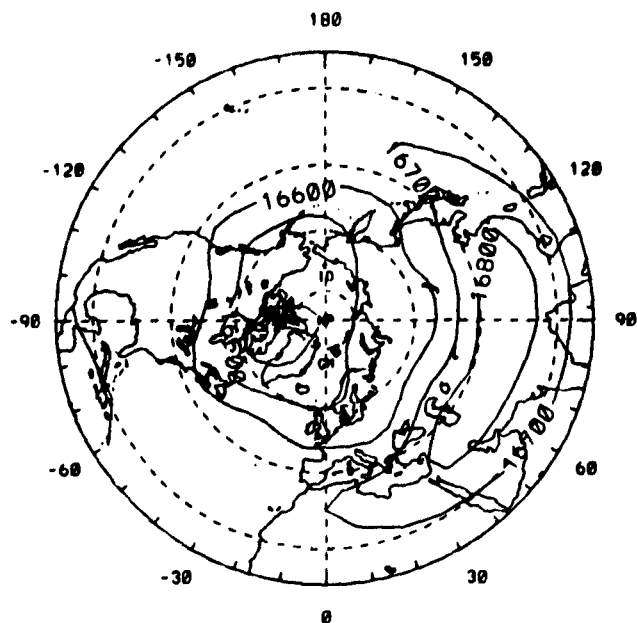
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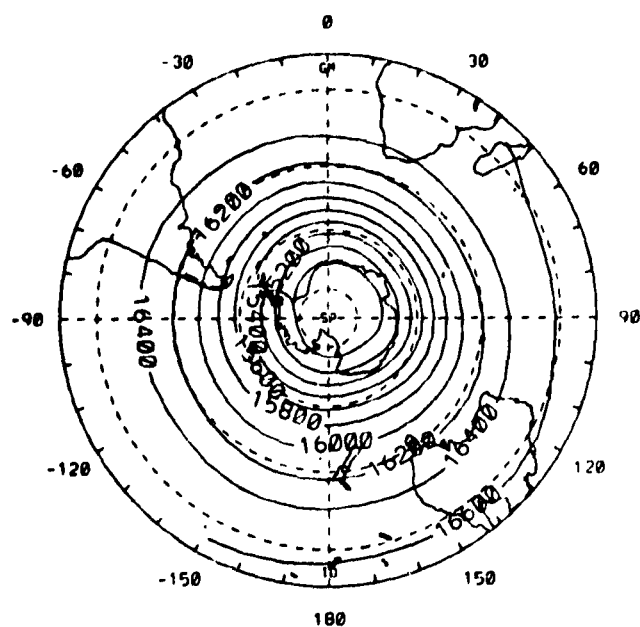
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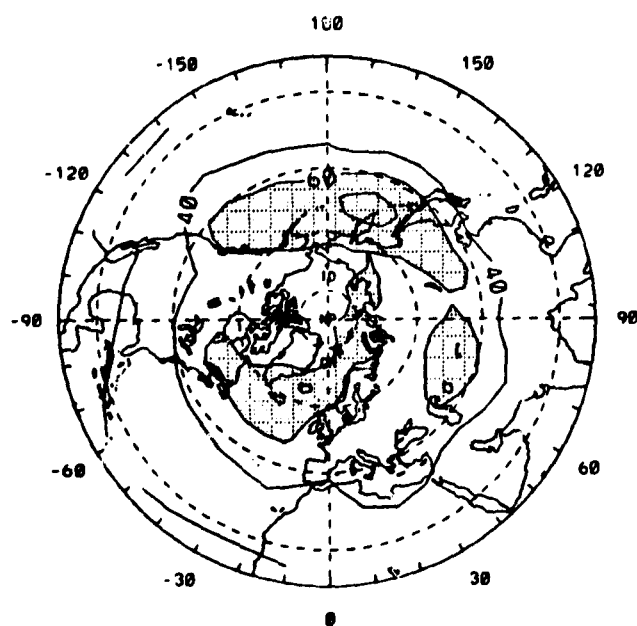
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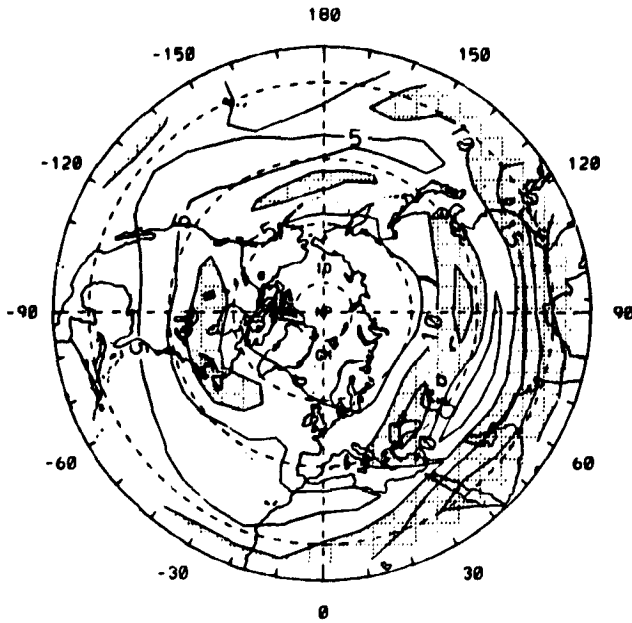


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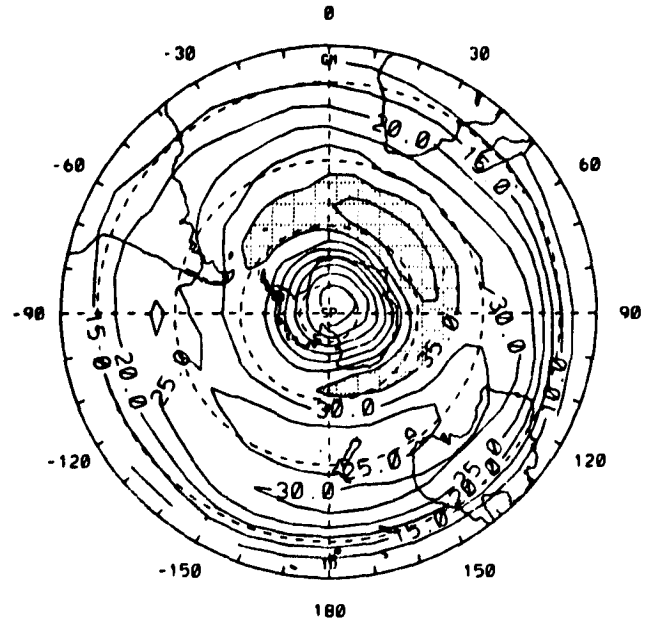


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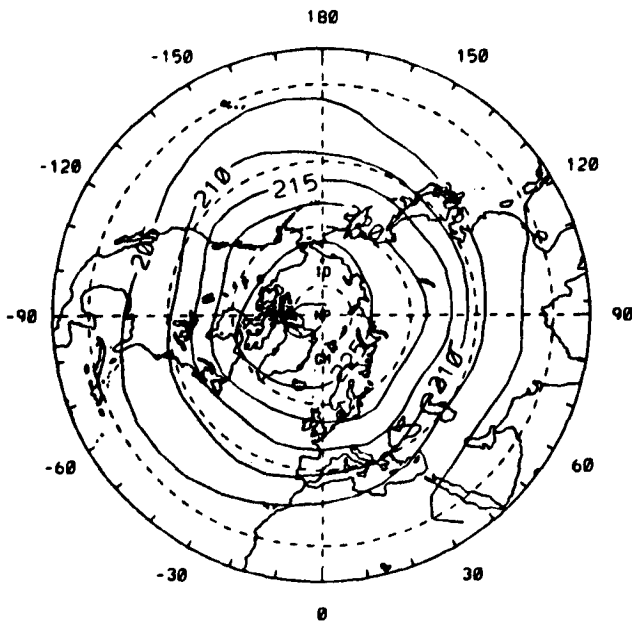
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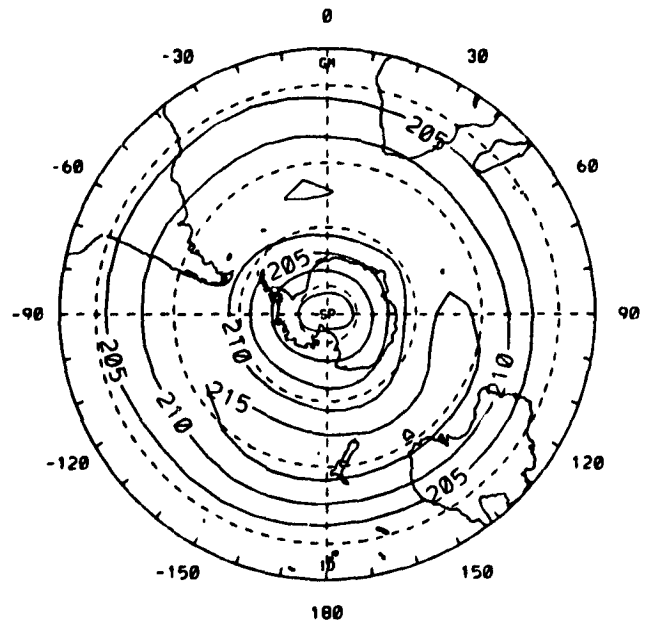
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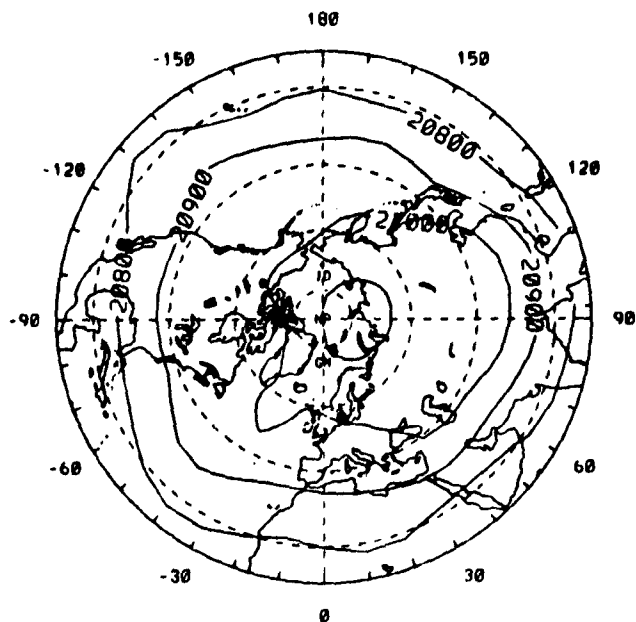
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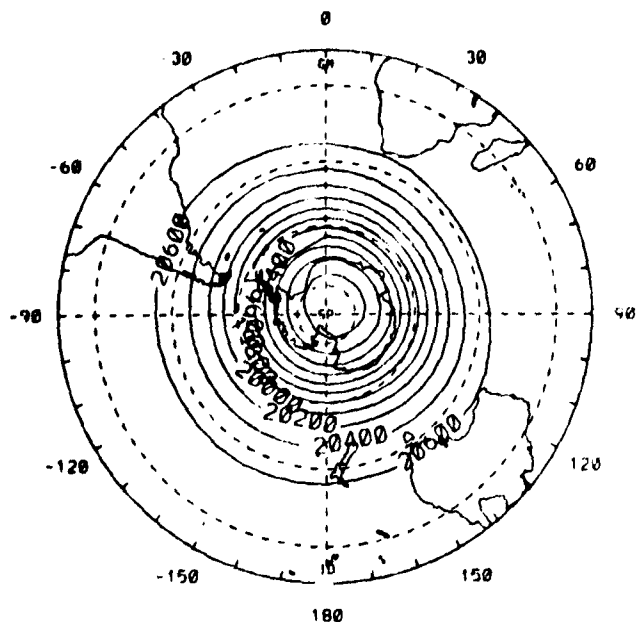
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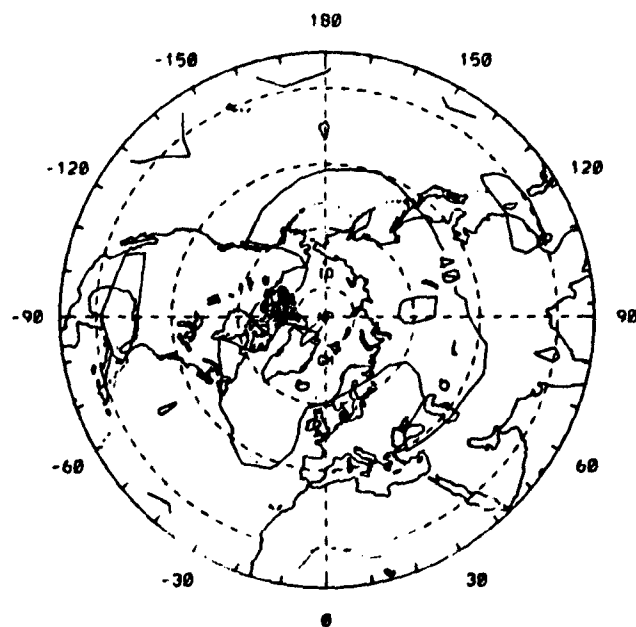
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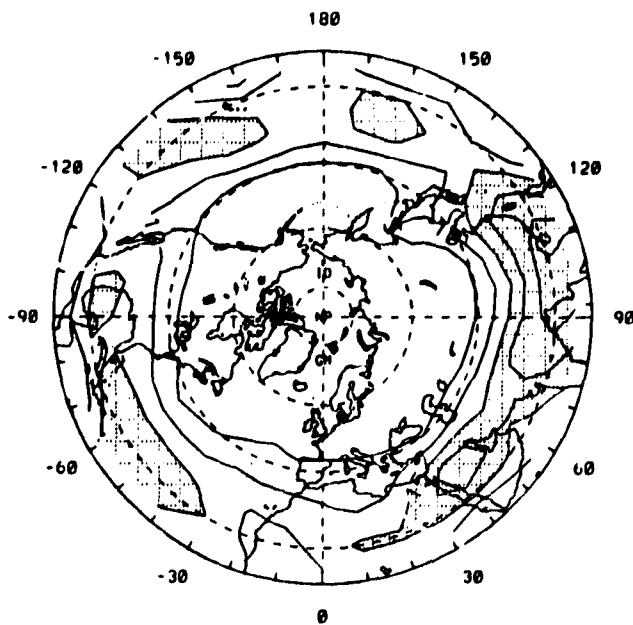
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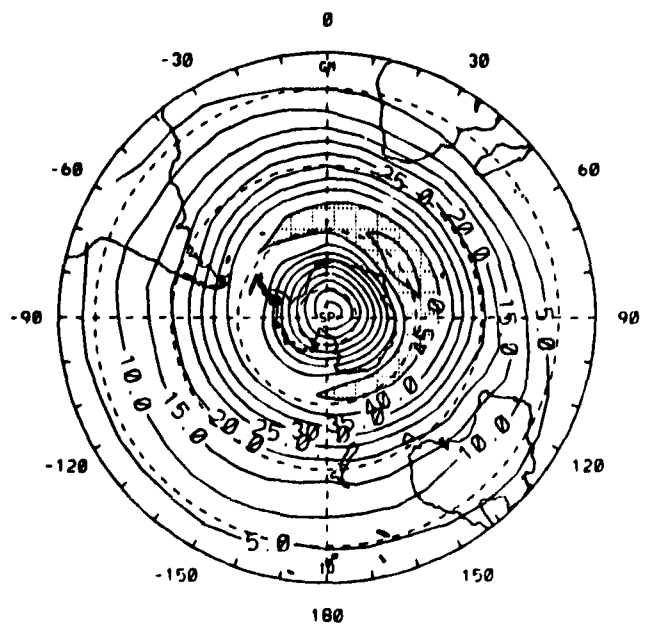
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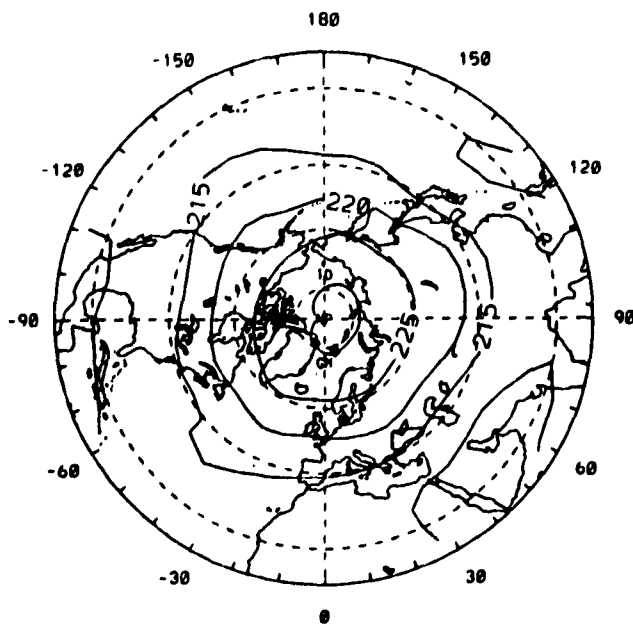
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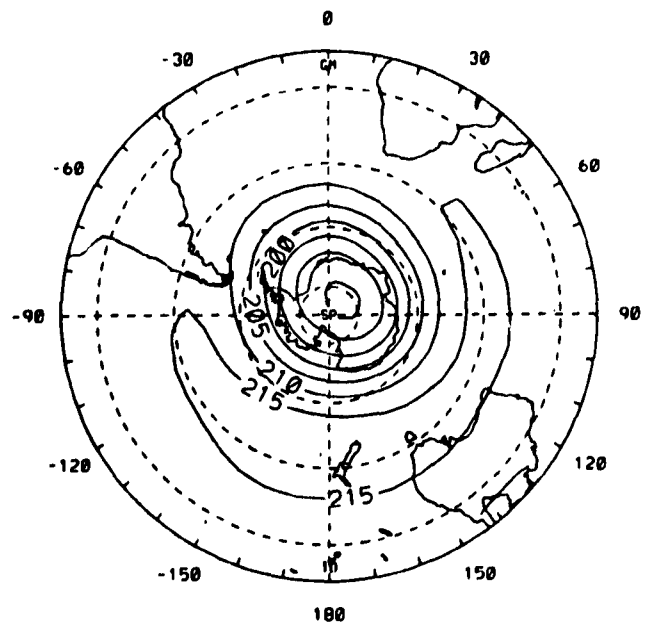
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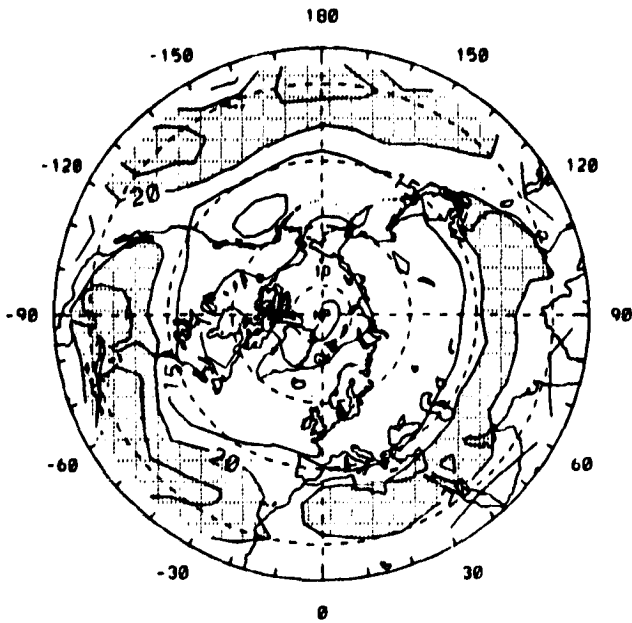
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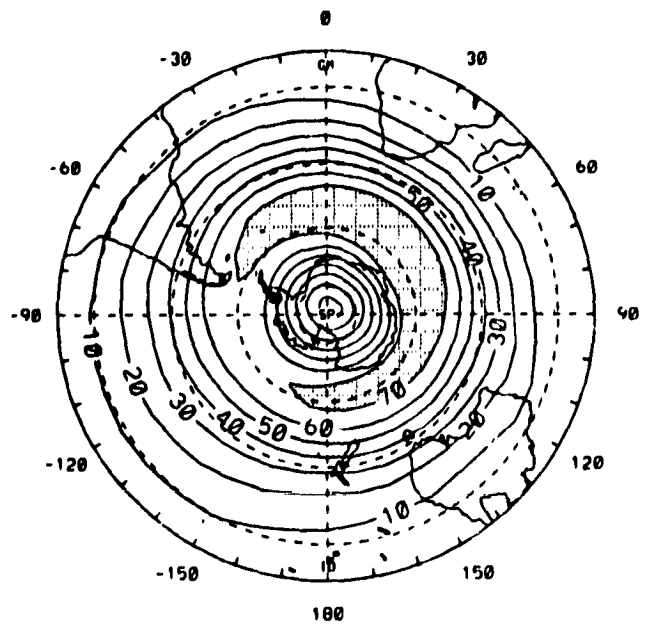
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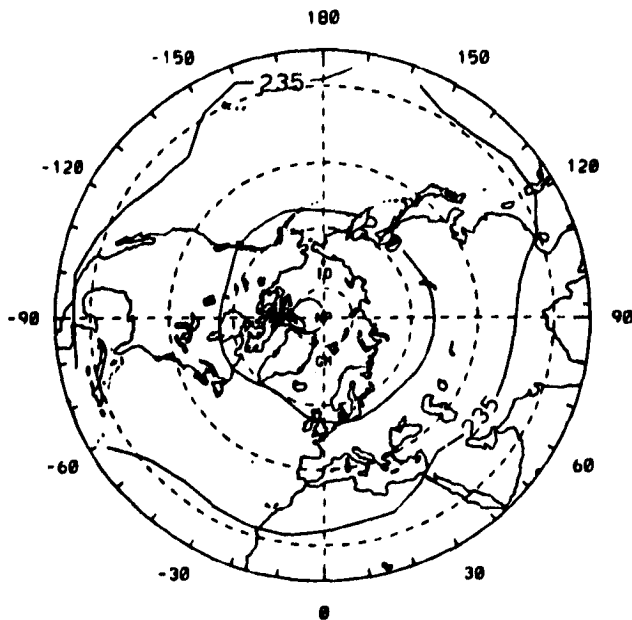
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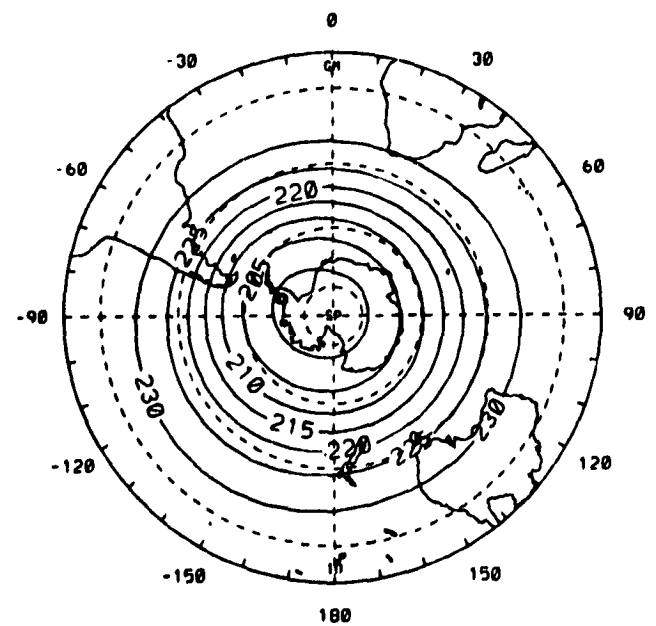
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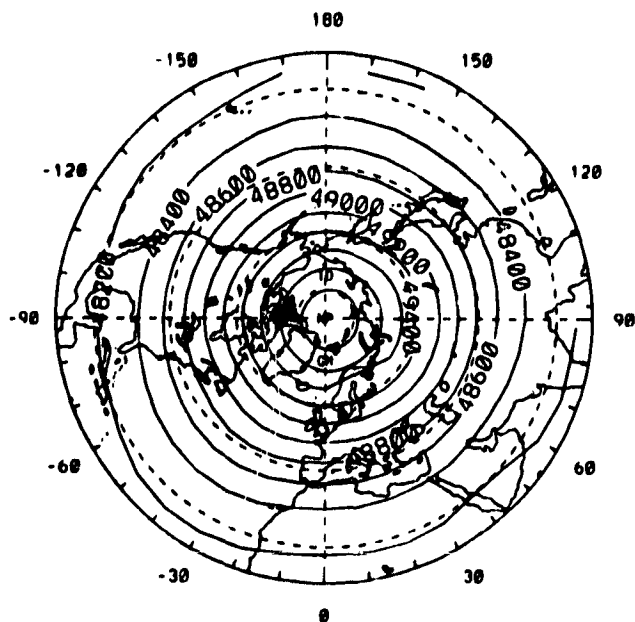
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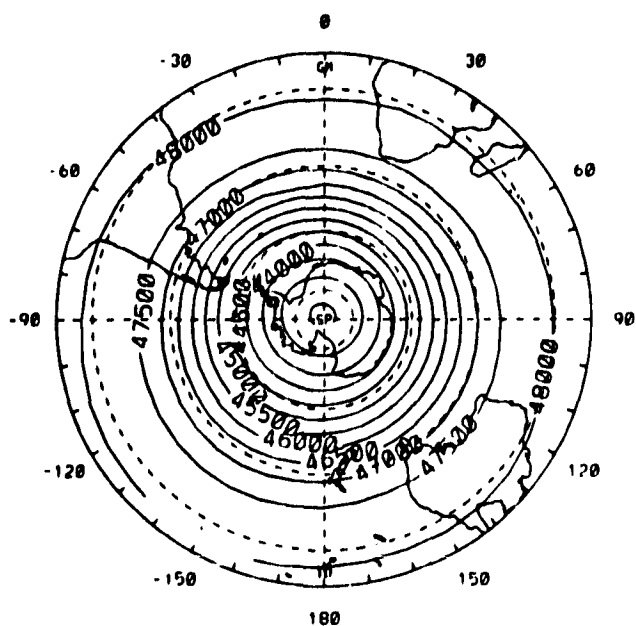
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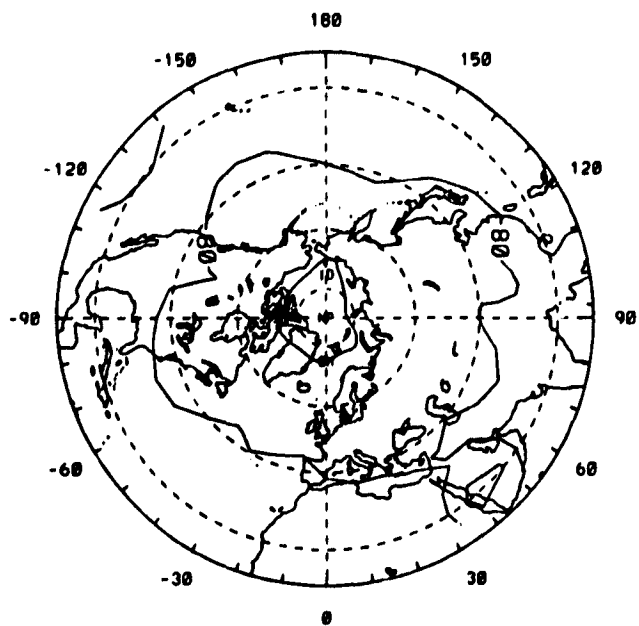
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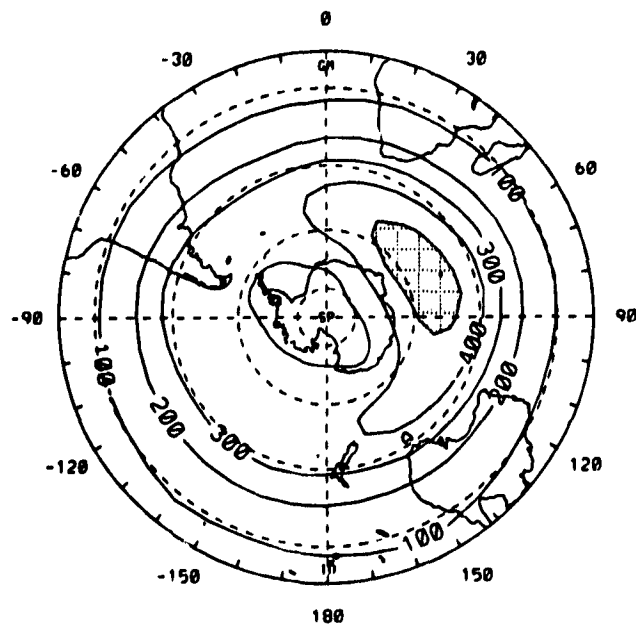
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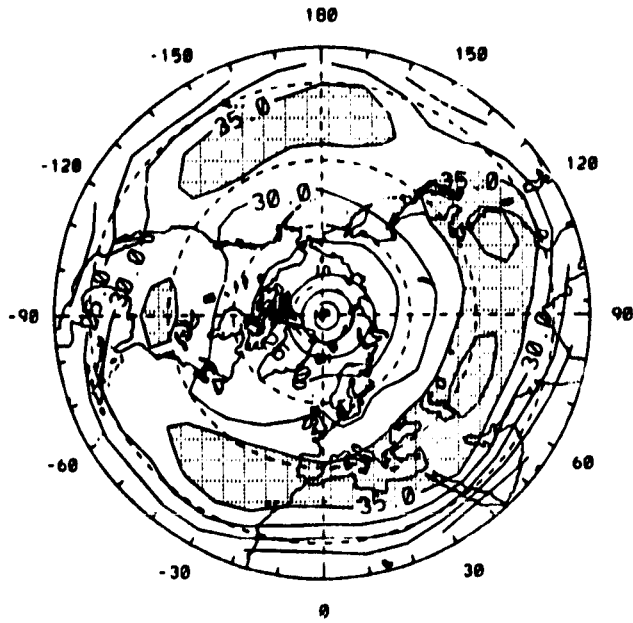
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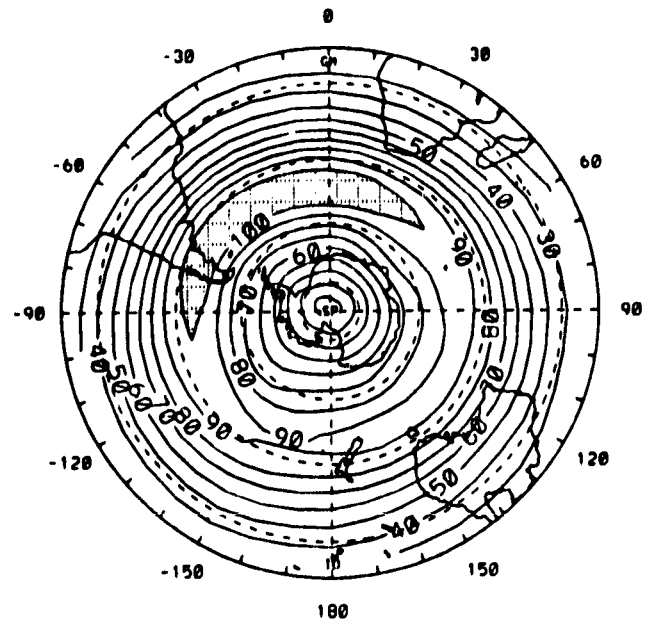
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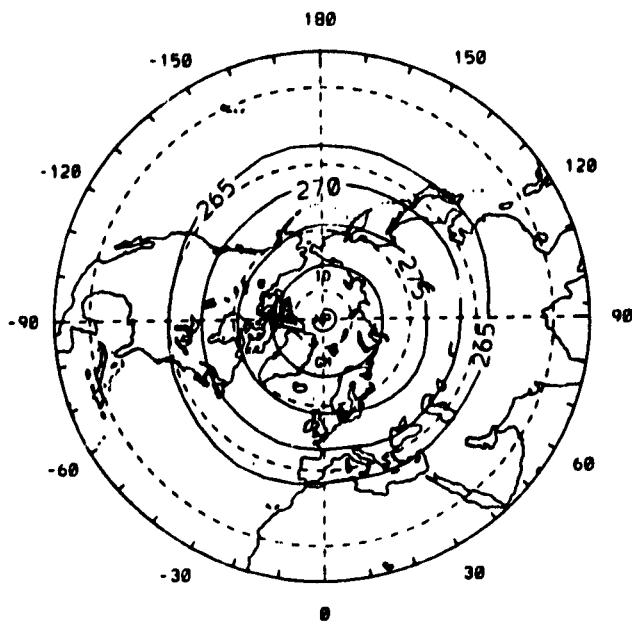
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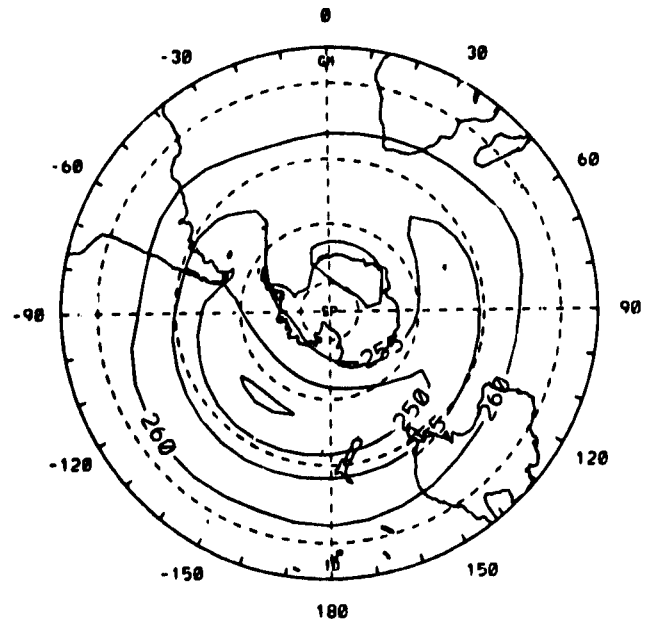
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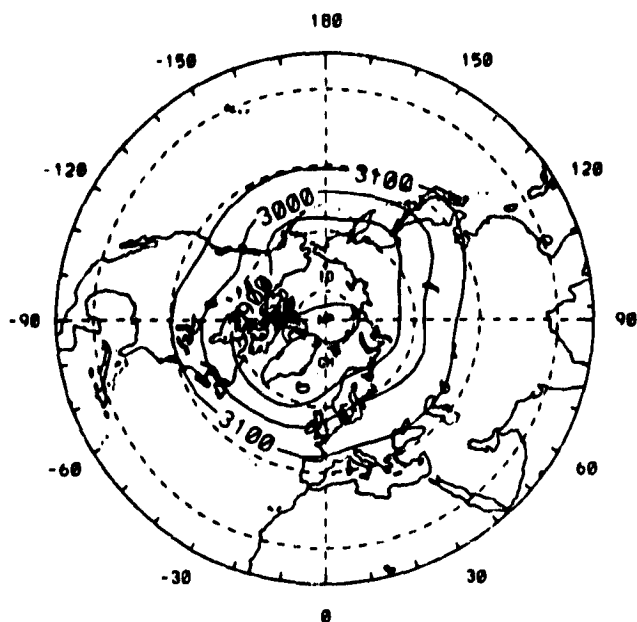
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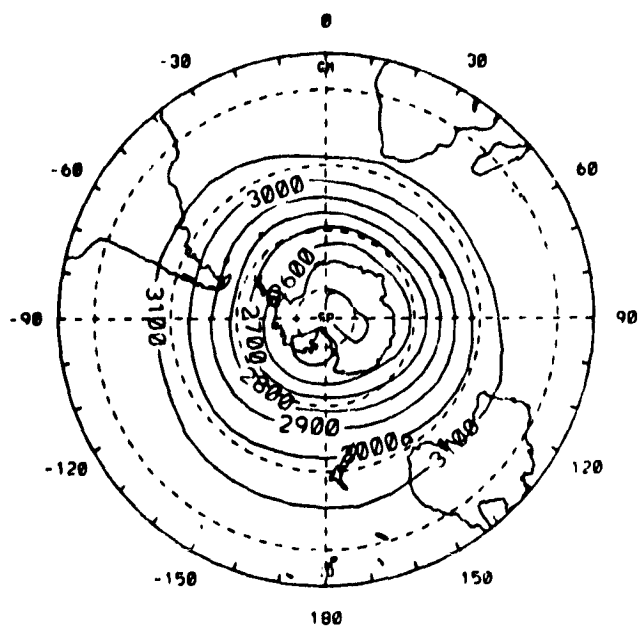
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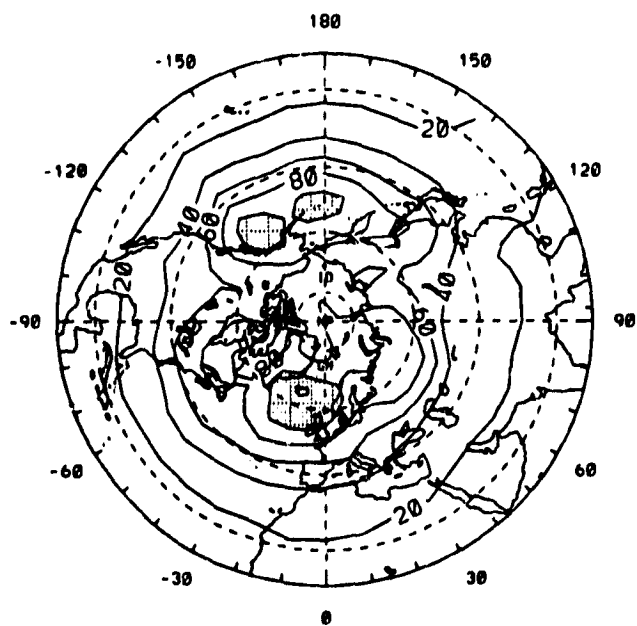
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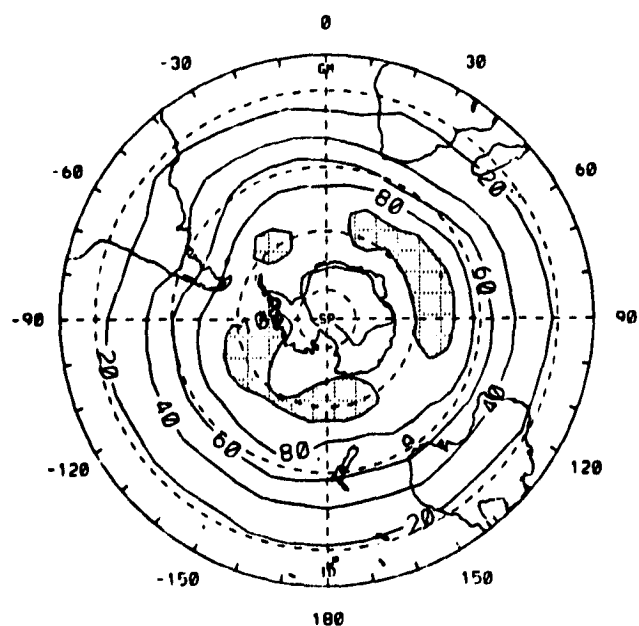
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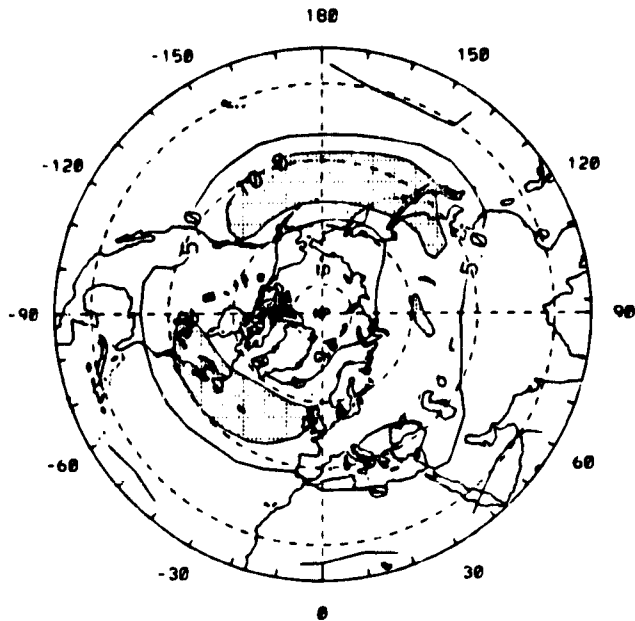
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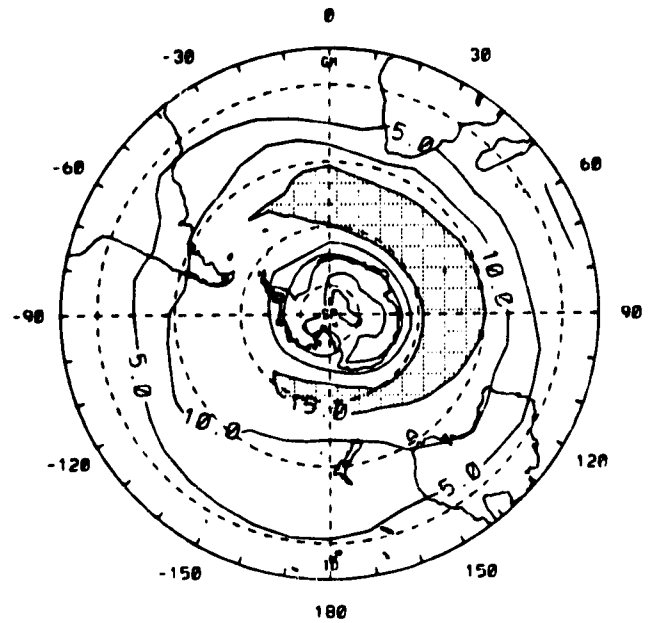
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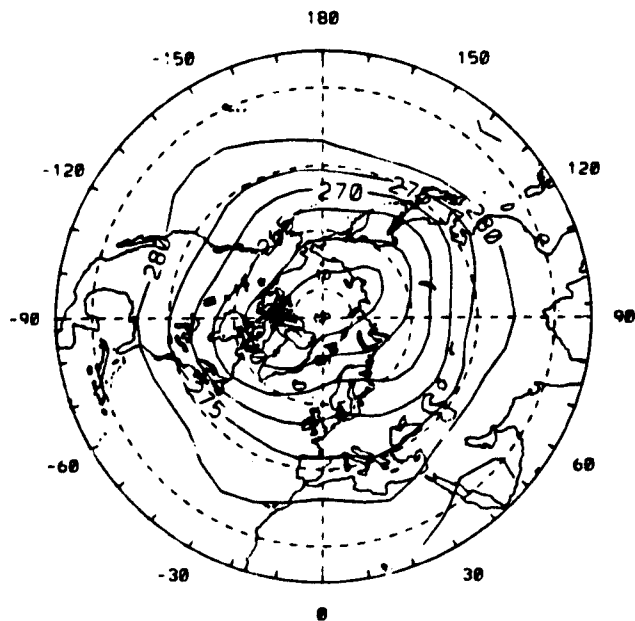
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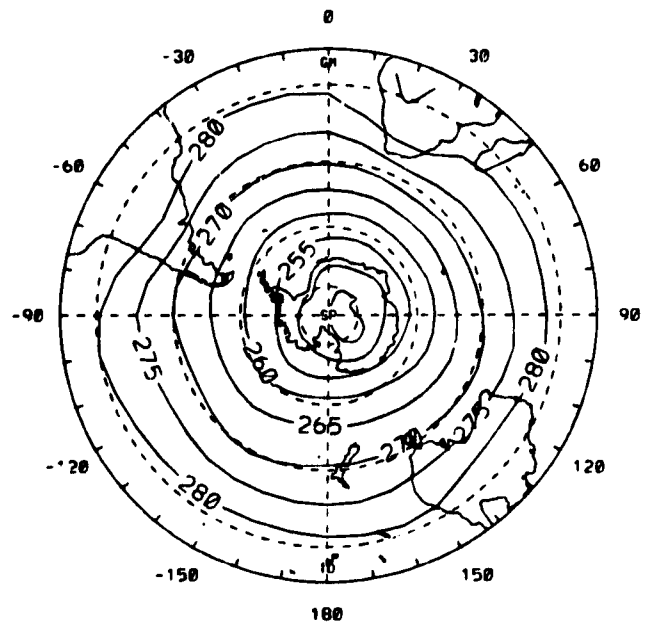
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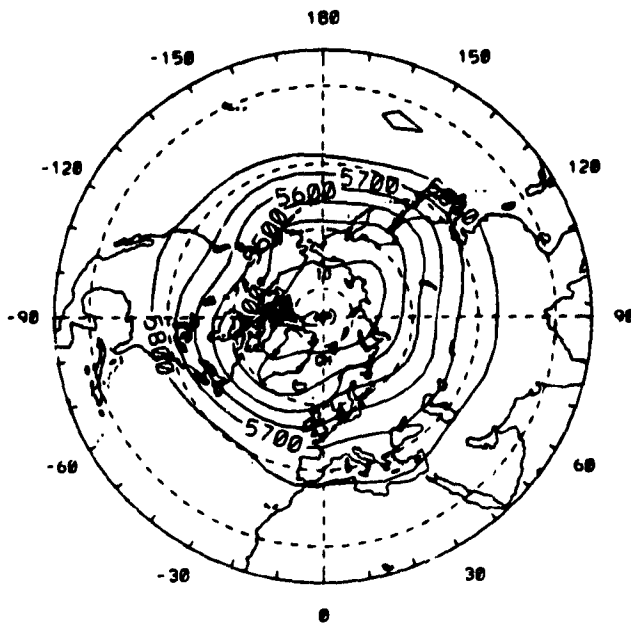
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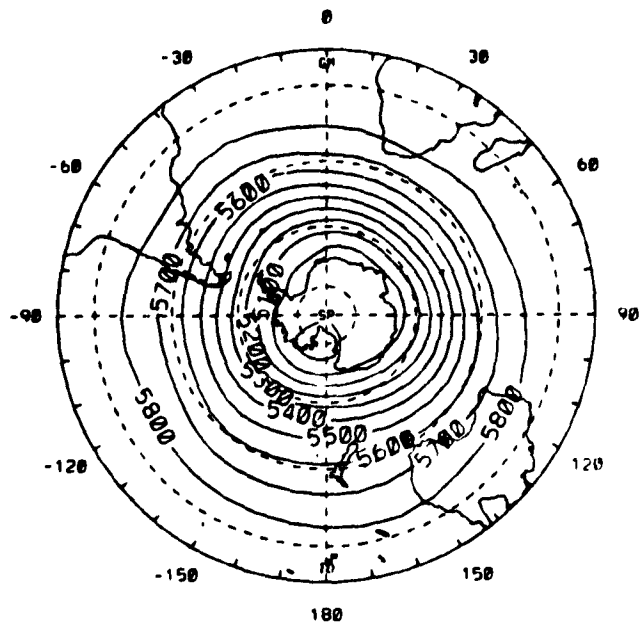
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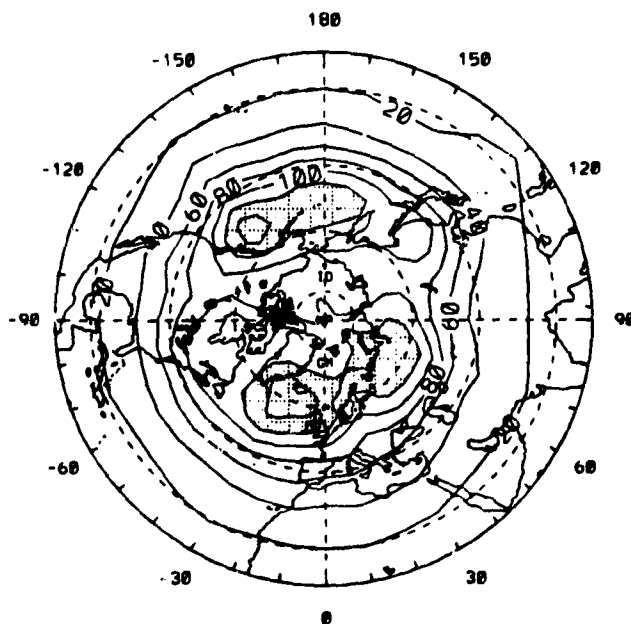
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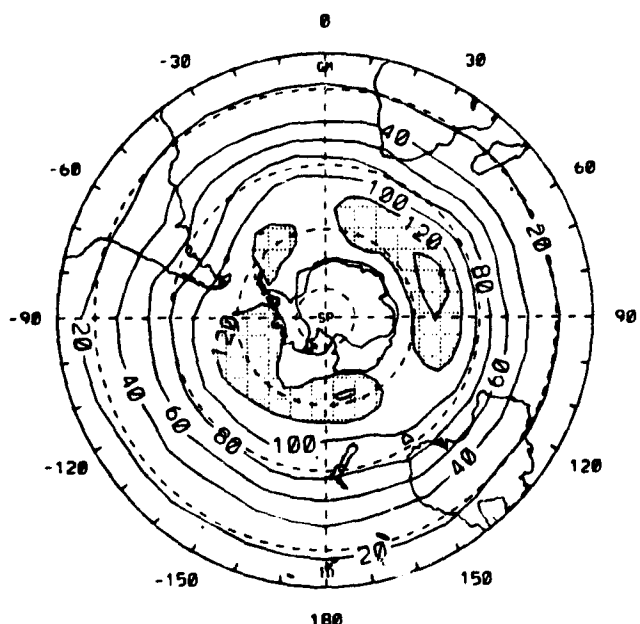
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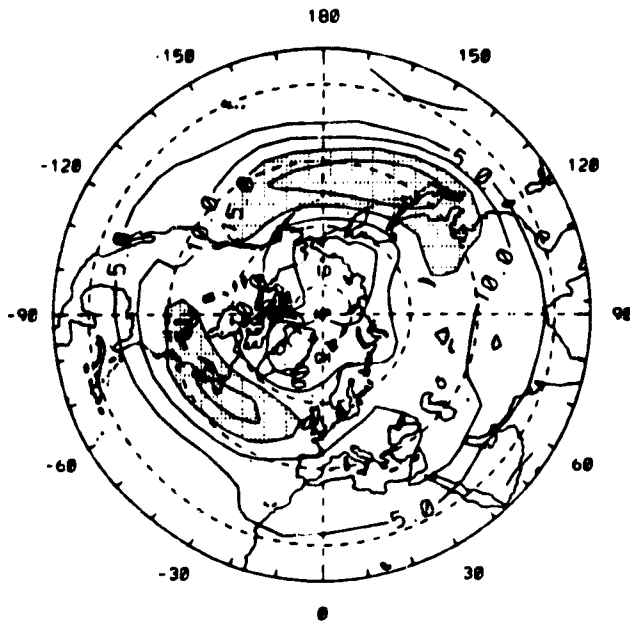
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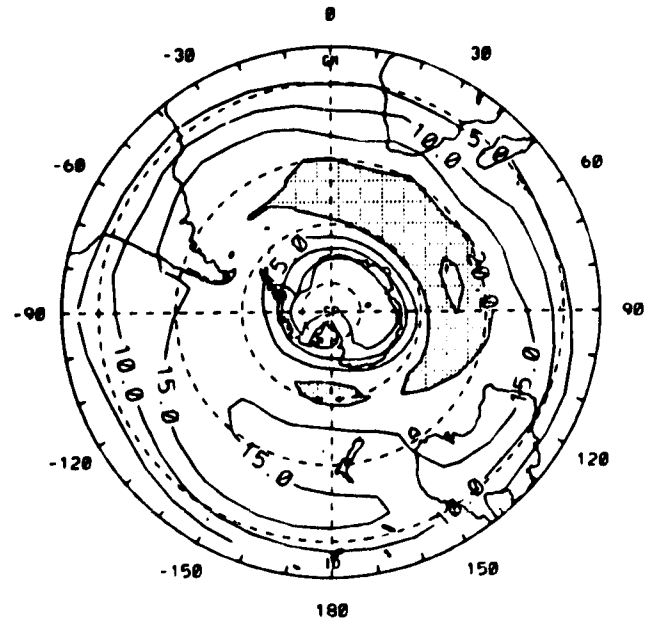
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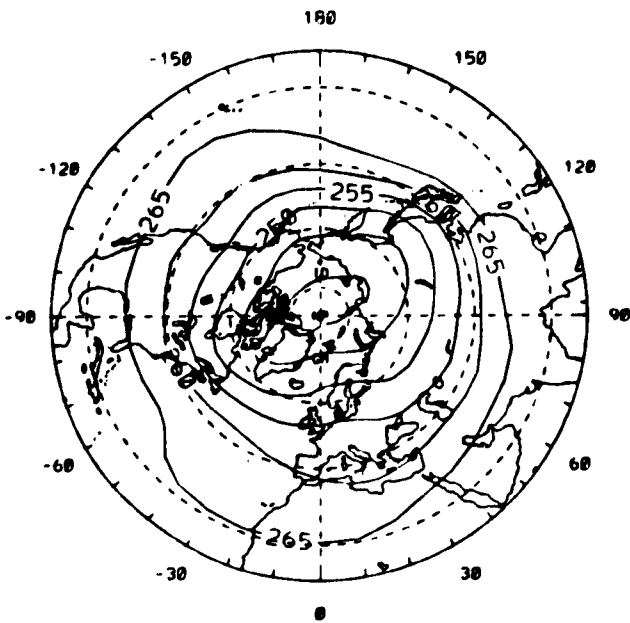
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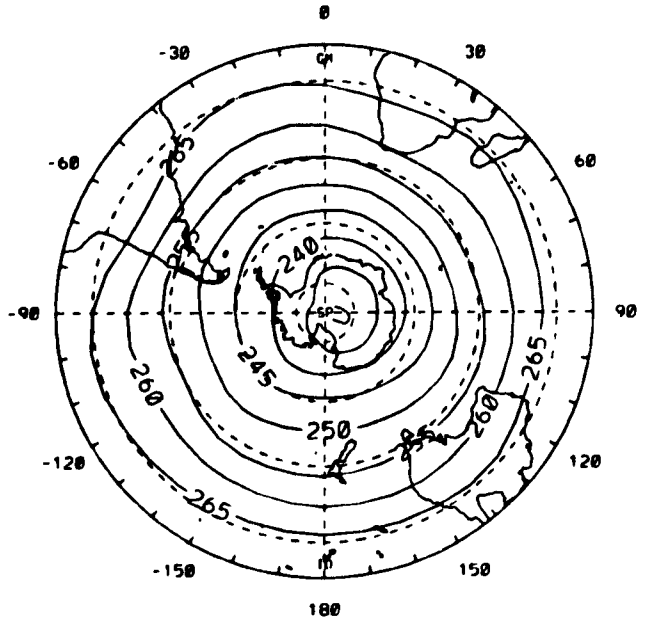
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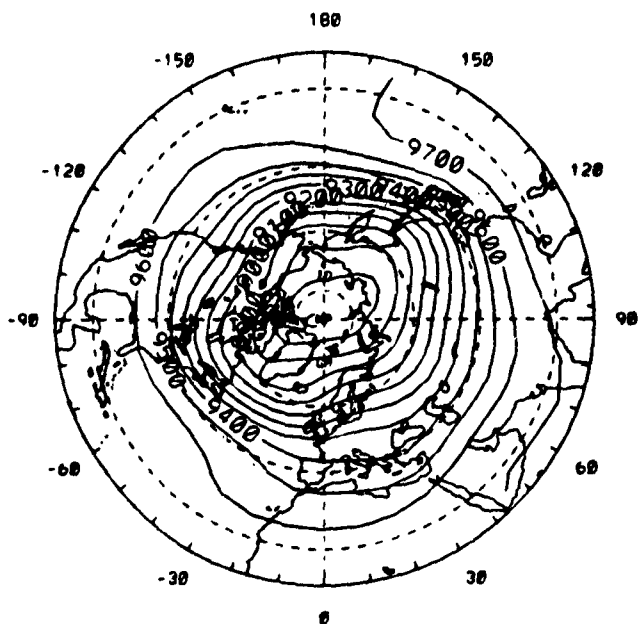
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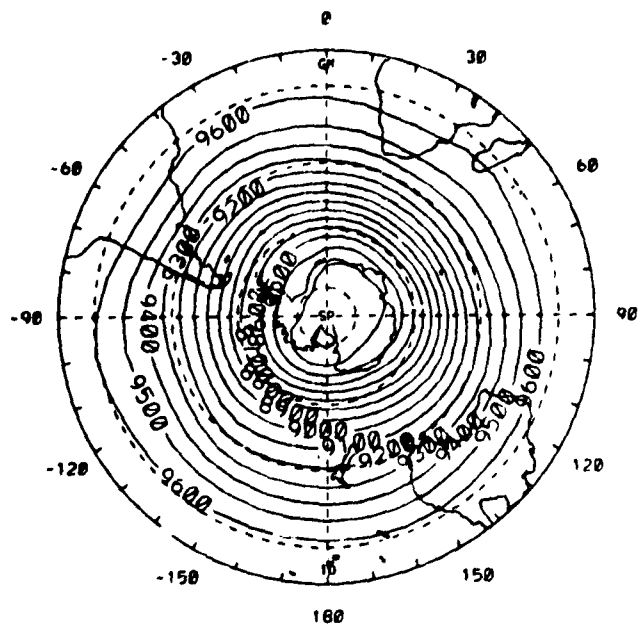
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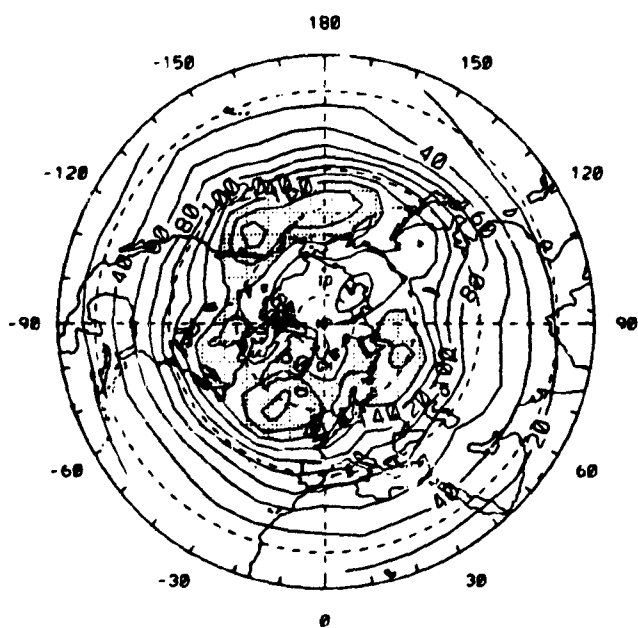
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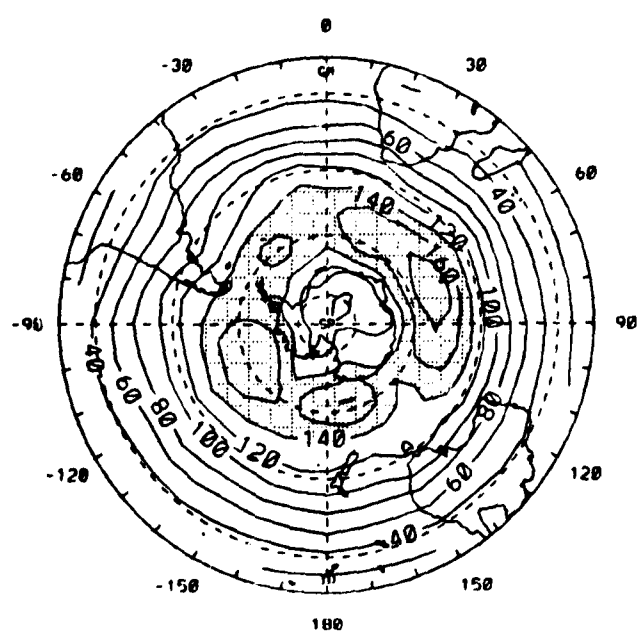
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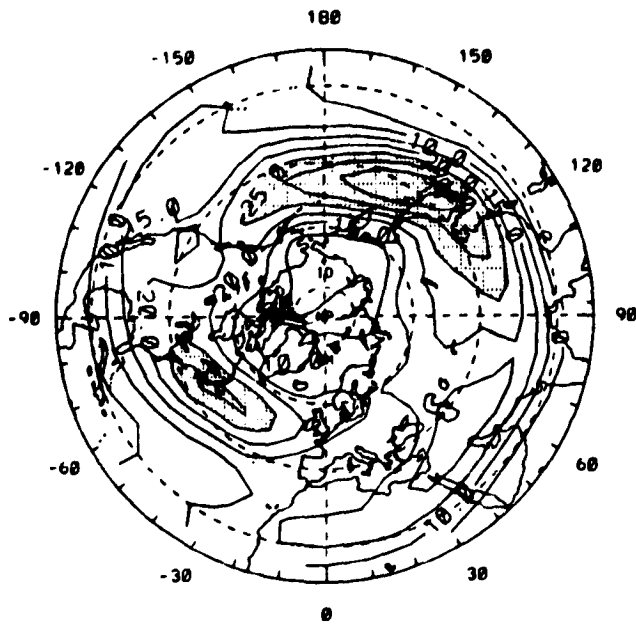
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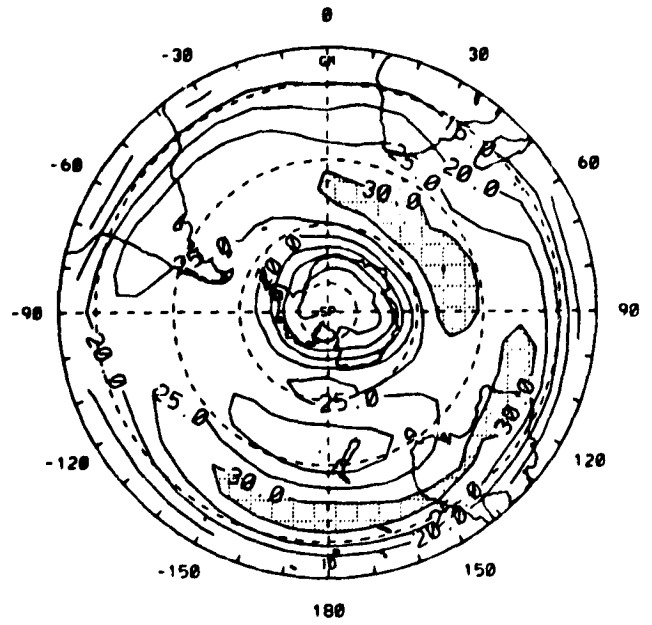
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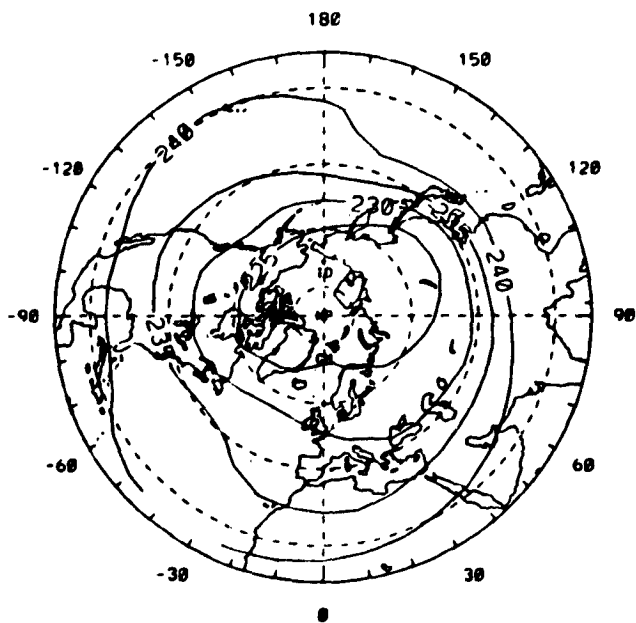
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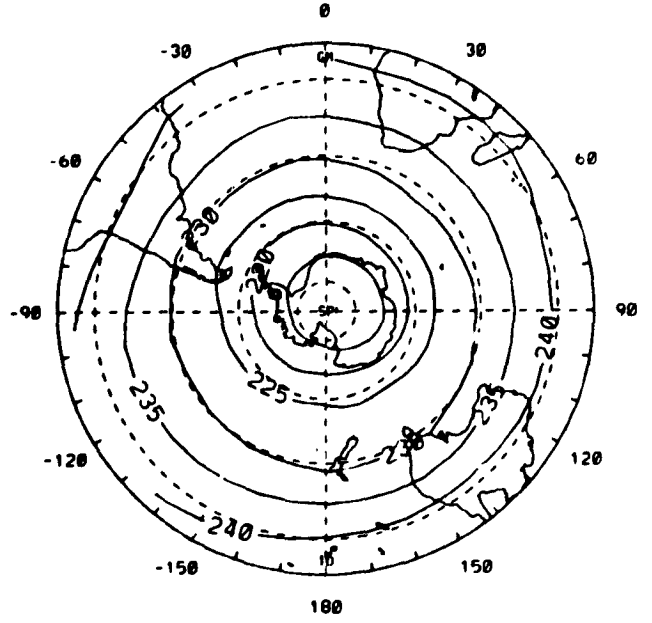
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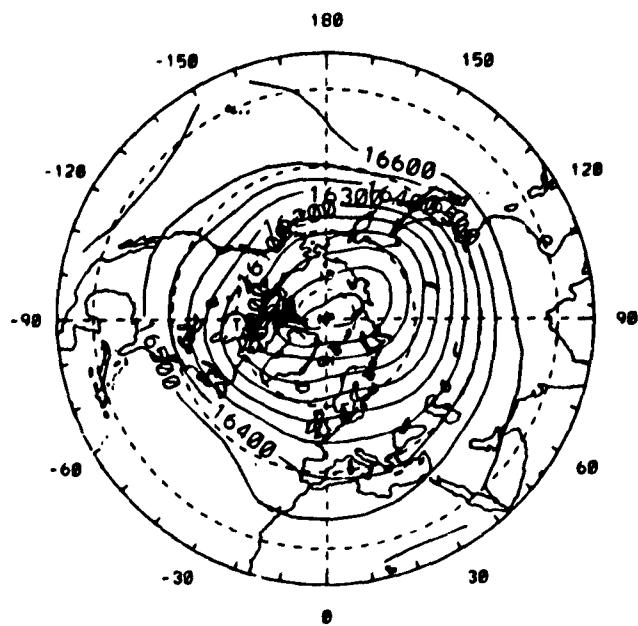
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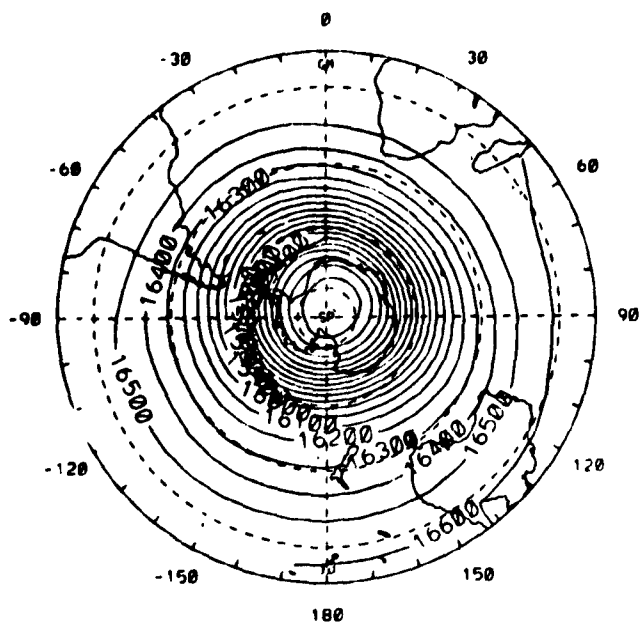
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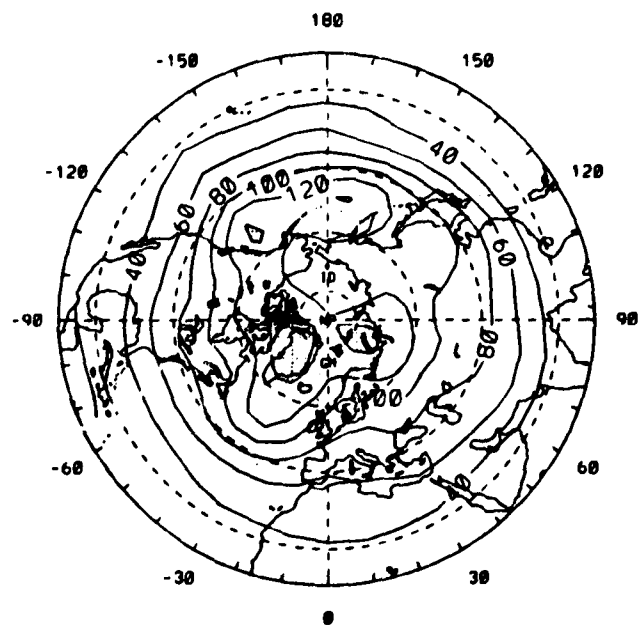
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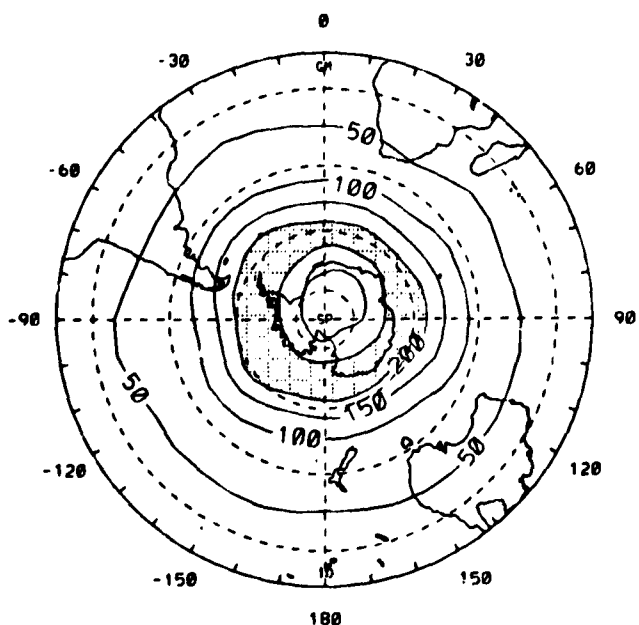
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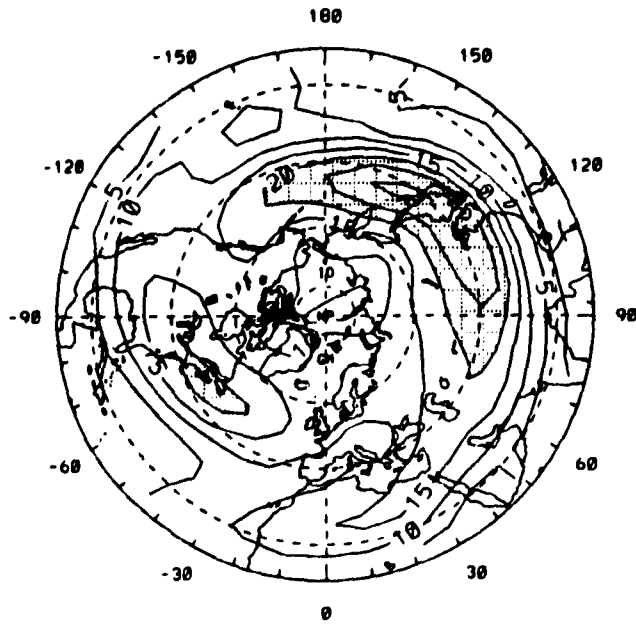
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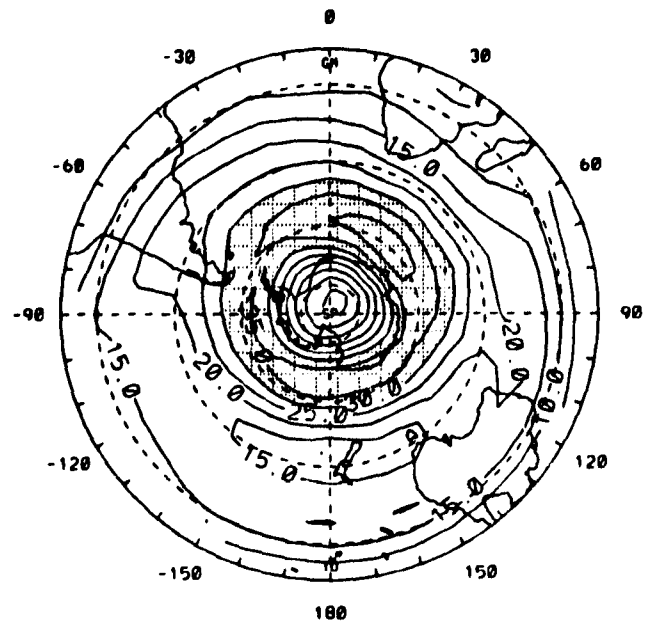
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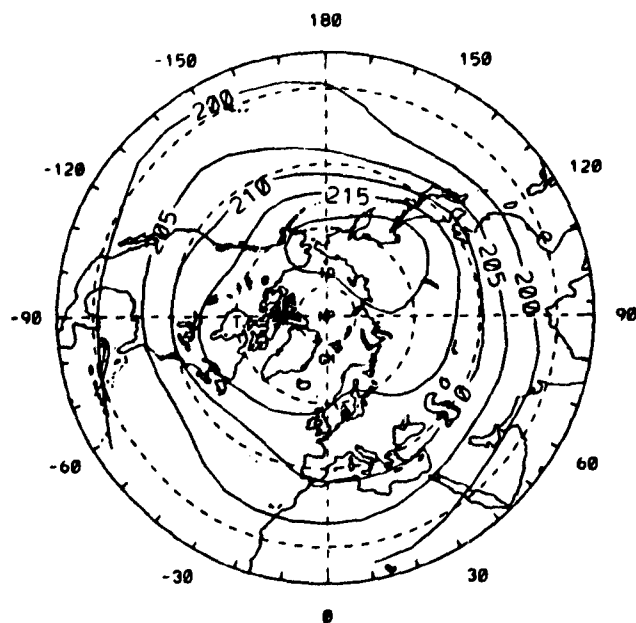
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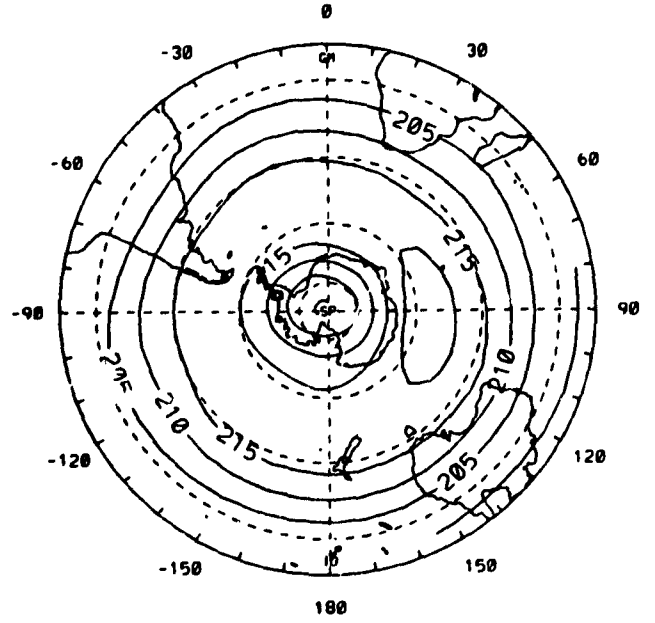
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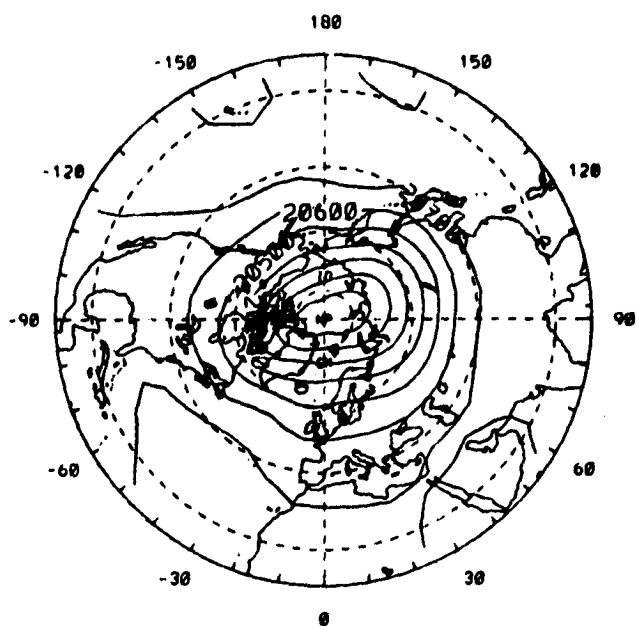
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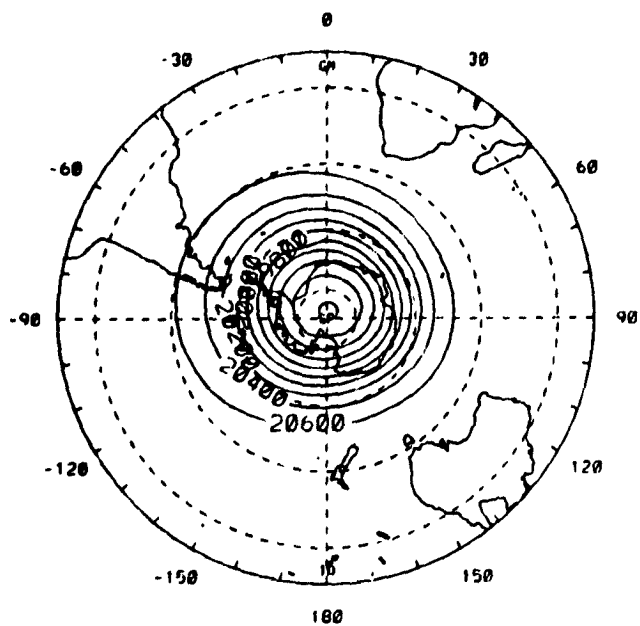
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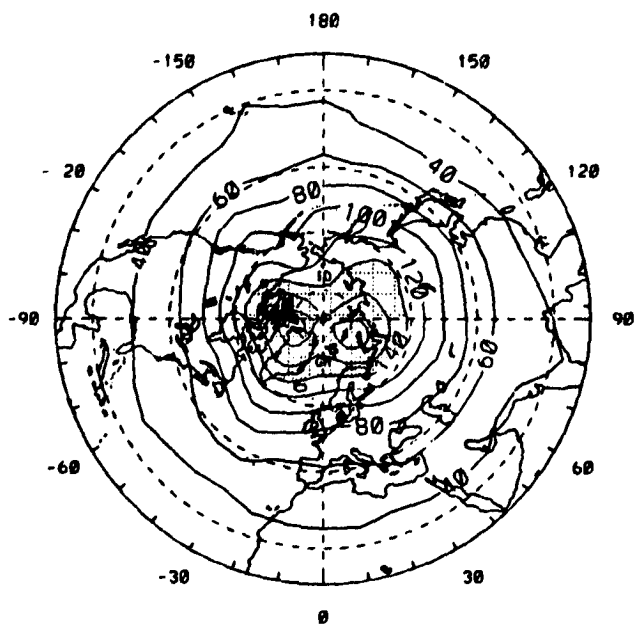
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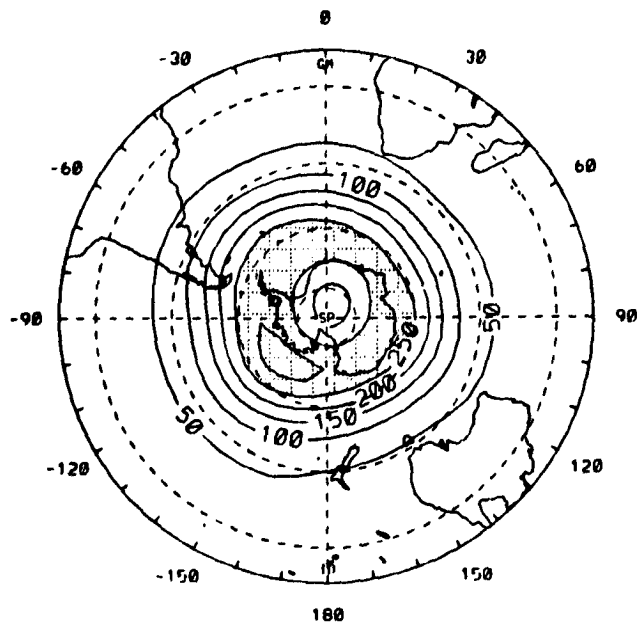
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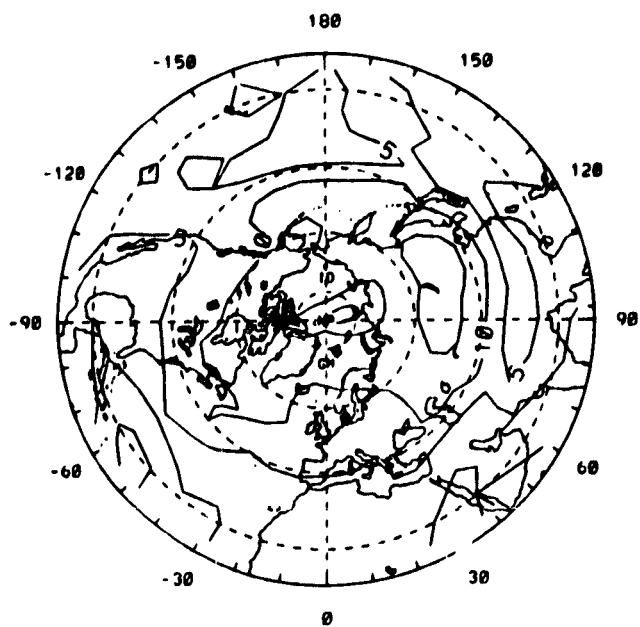
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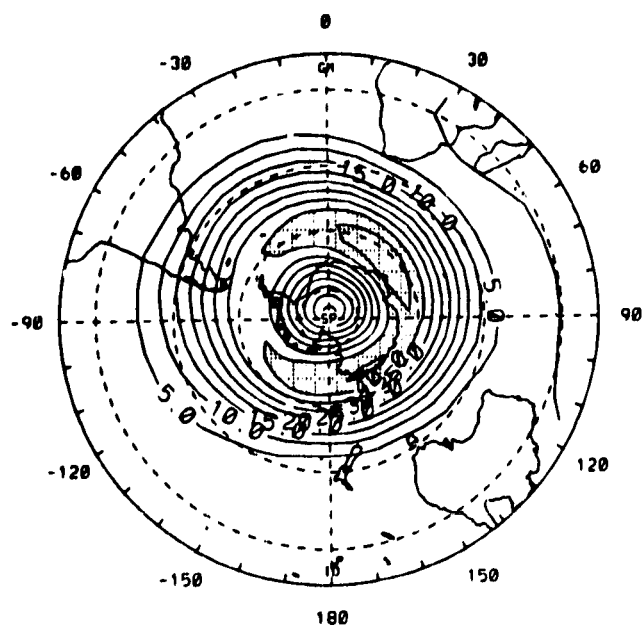
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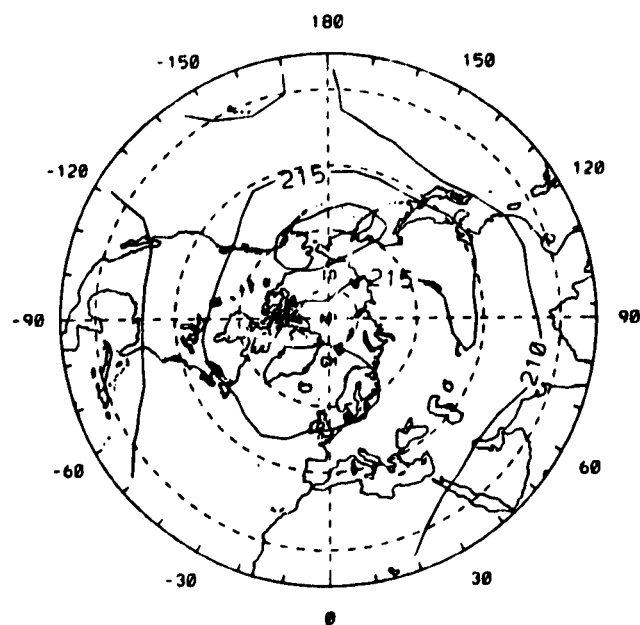
OCTOBER NH 50 MB WIND SPEED



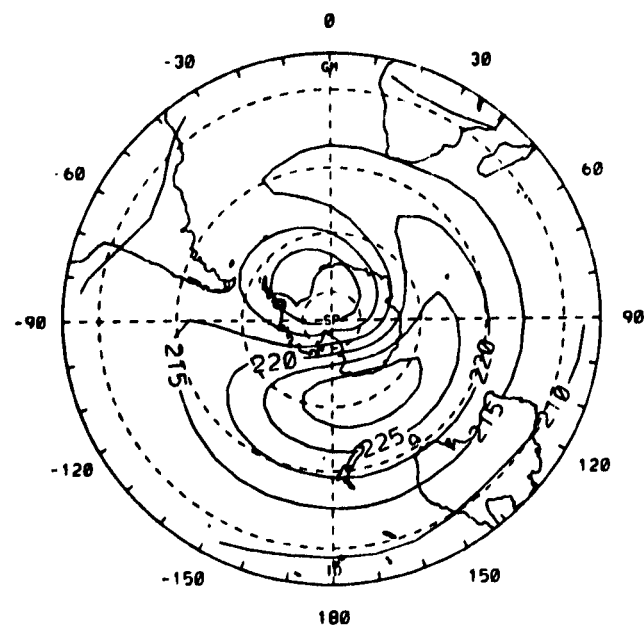
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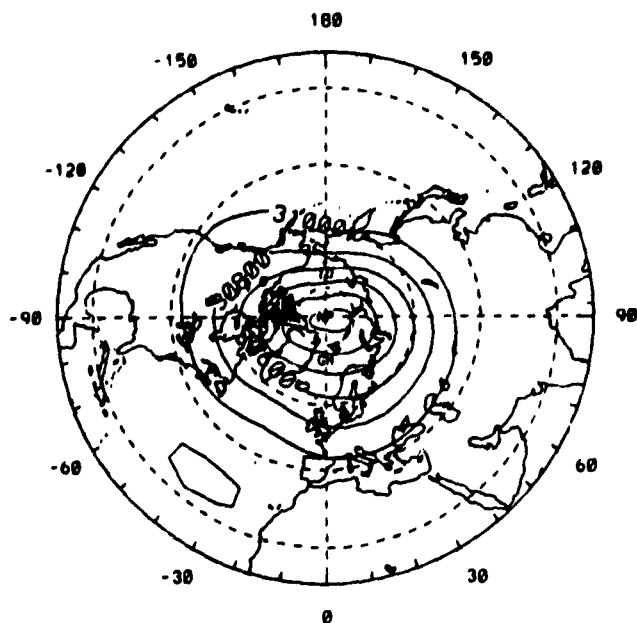
OCTOBER NH 50 MB TEMPERATURE



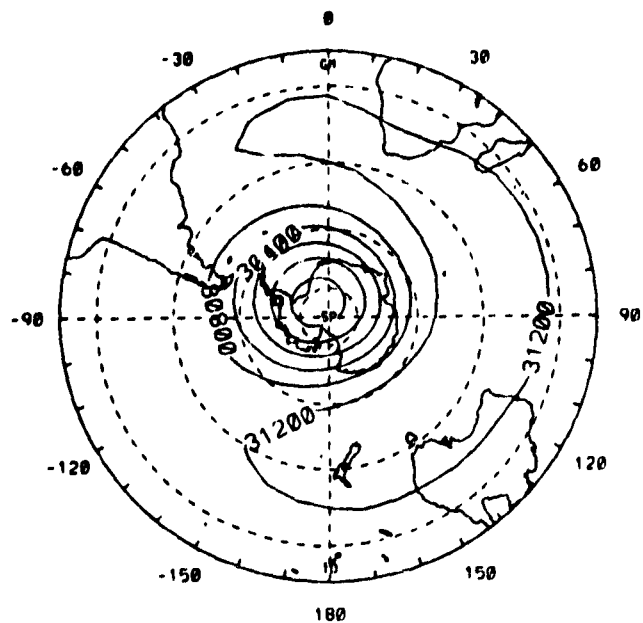
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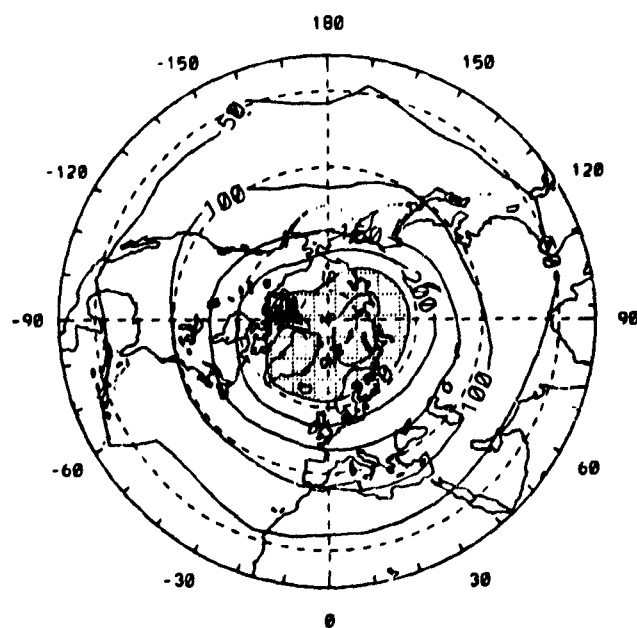
OCTOBER NH 10 MB HEIGHT



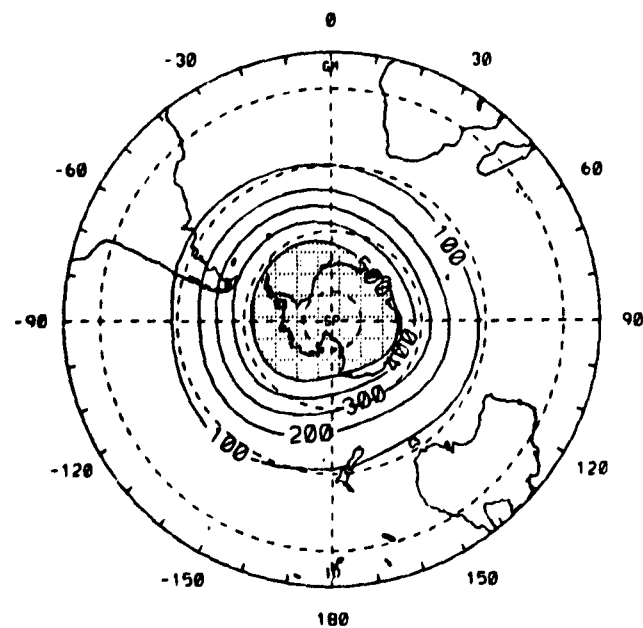
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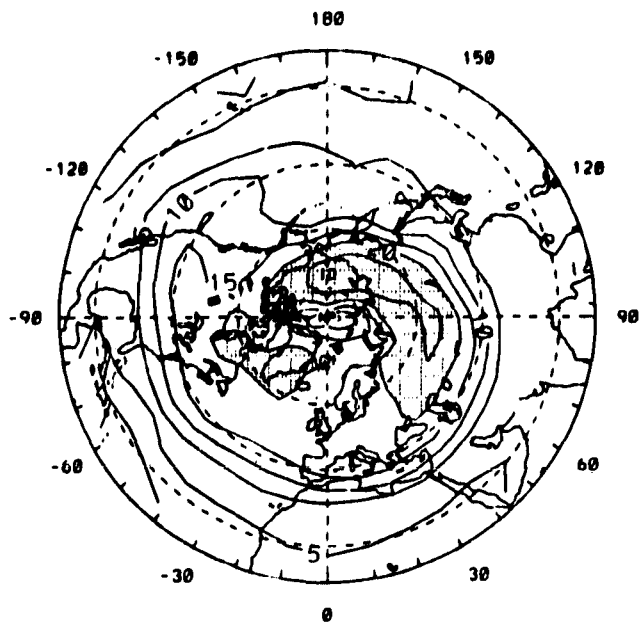
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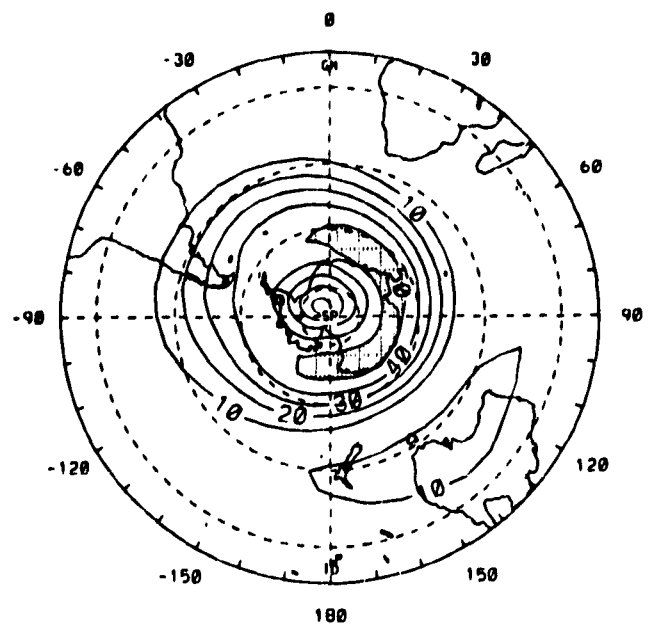
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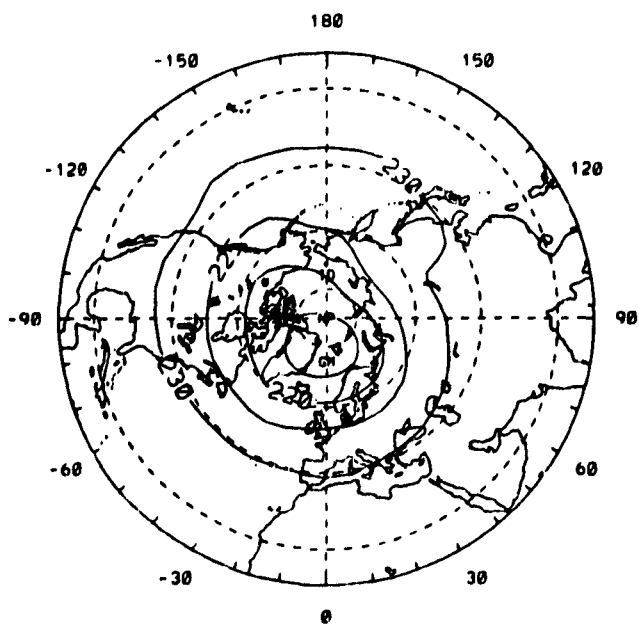
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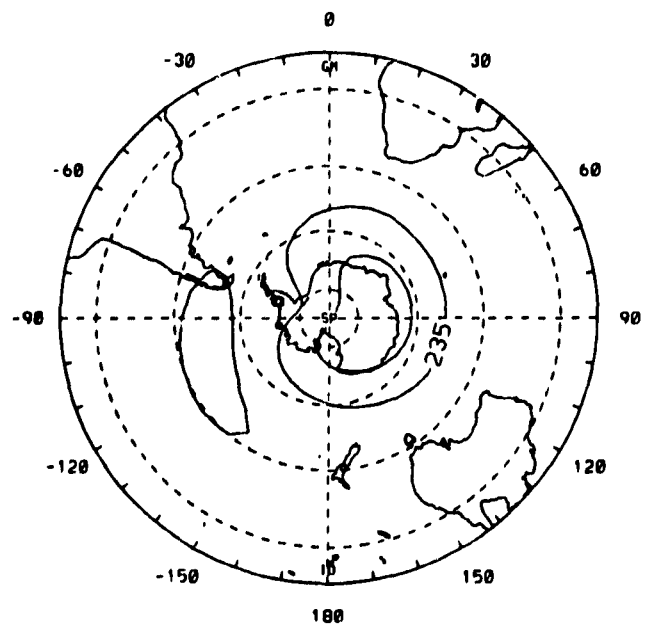
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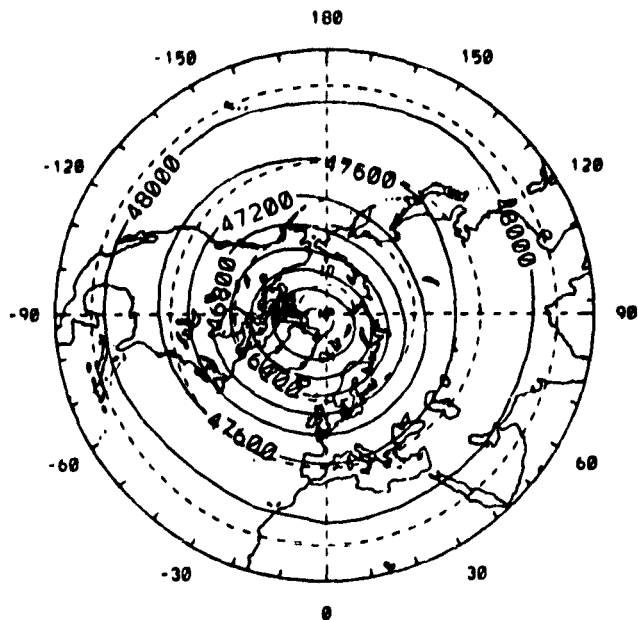
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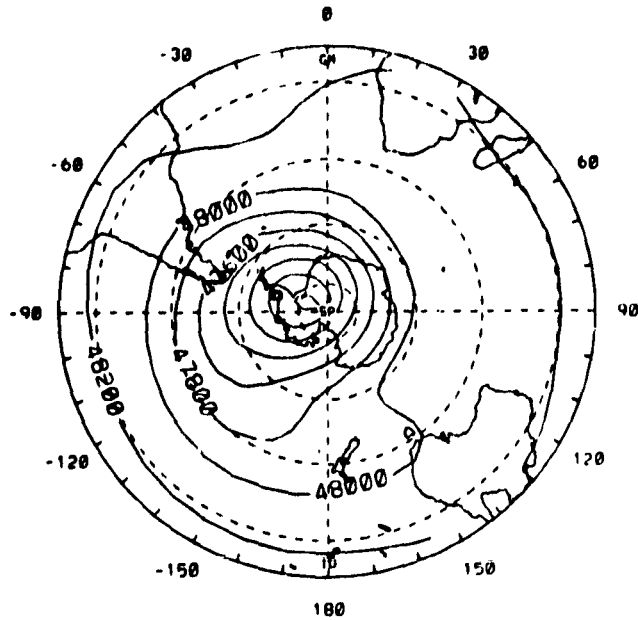
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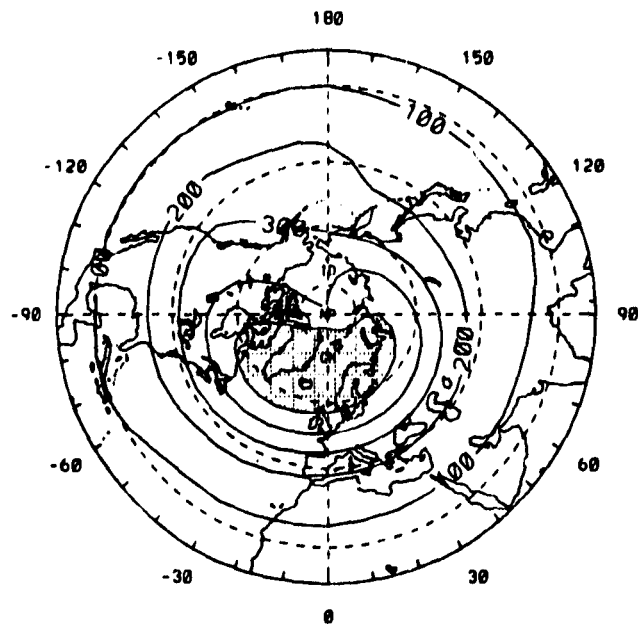
OCTOBER NH 1 MB HEIGHT



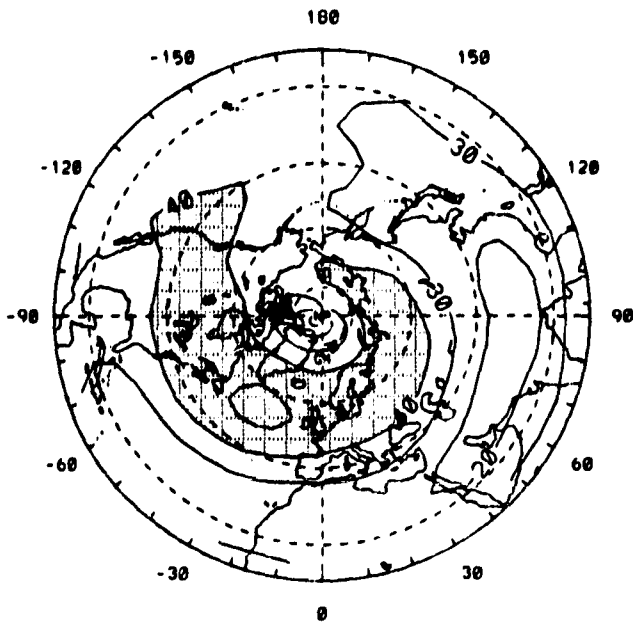
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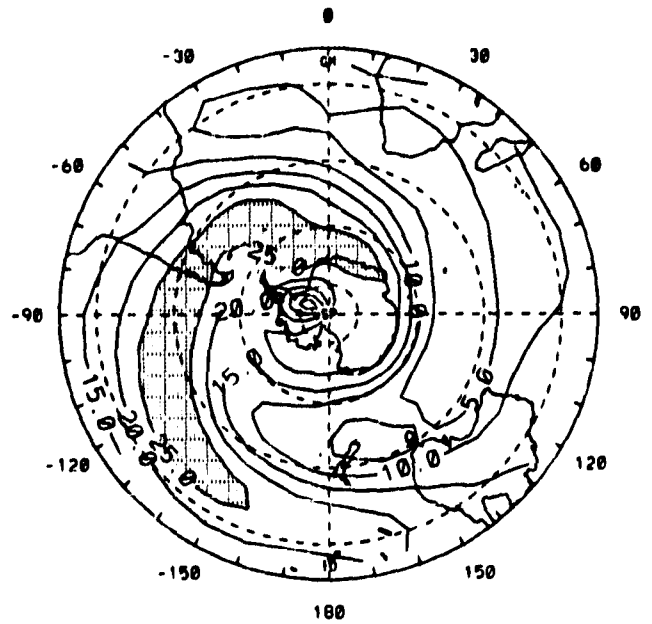
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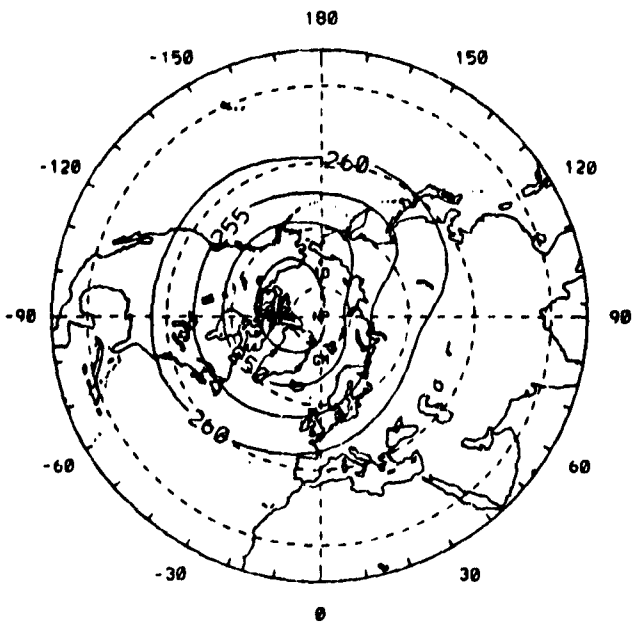
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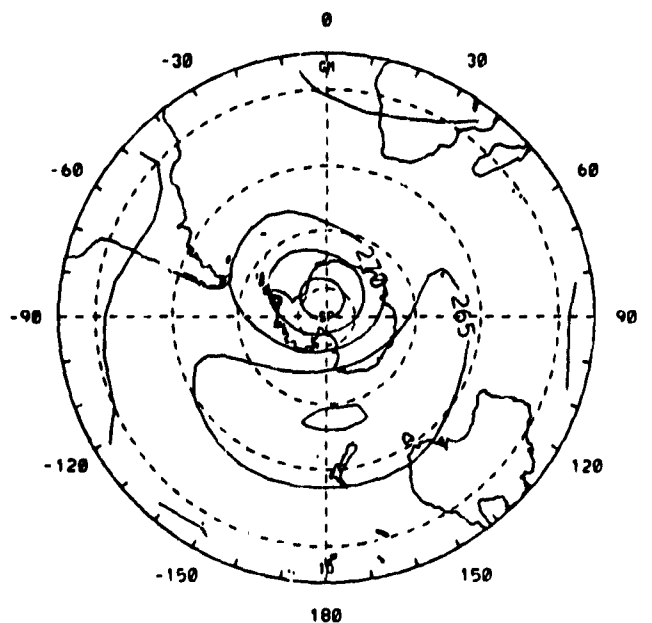
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OCTOBER NH 1 MB TEMPERATURE



OCTOBER SH 1 MB TEMPERATURE

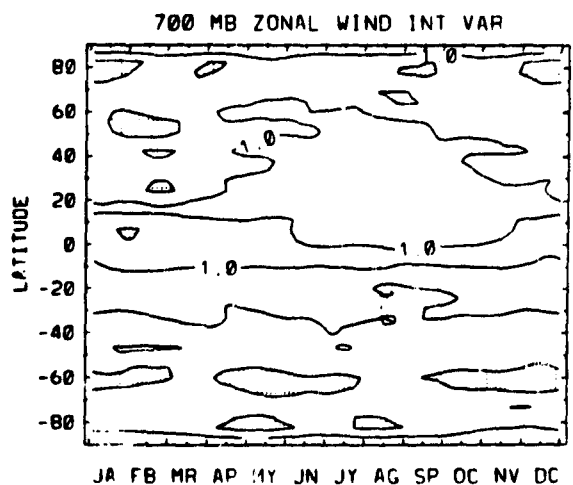
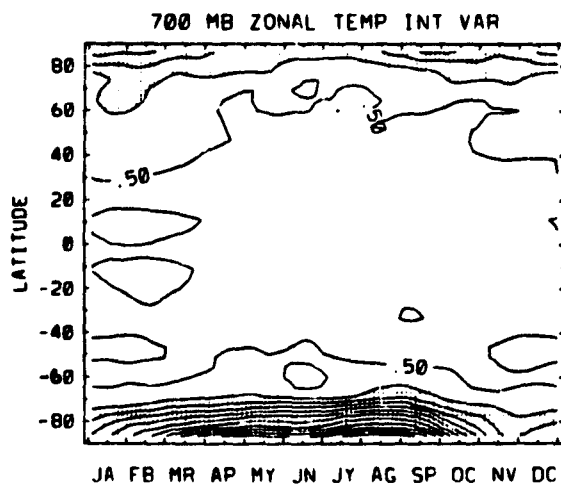
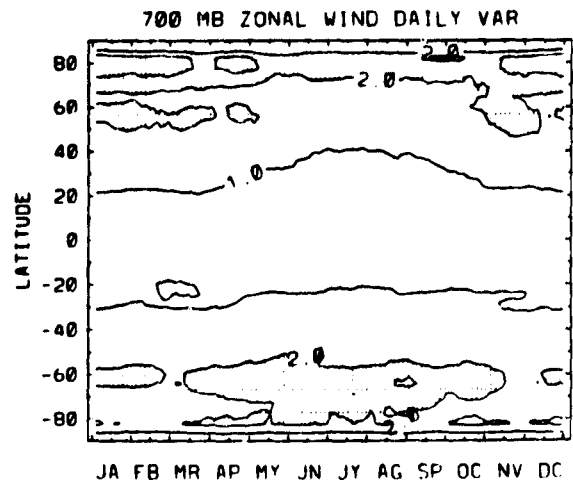
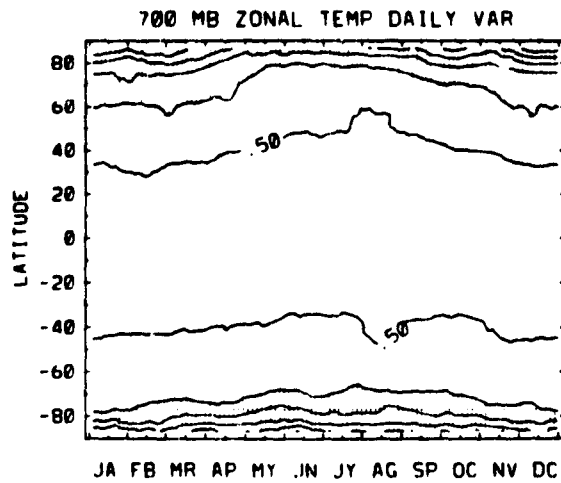
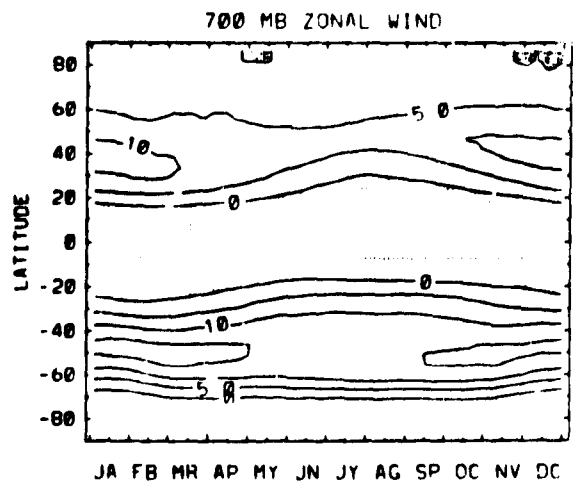
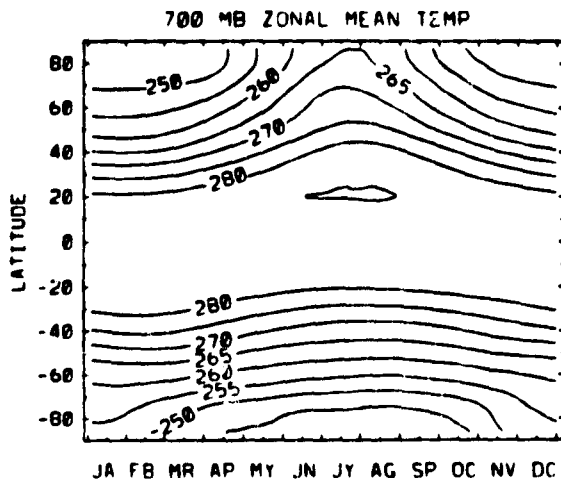


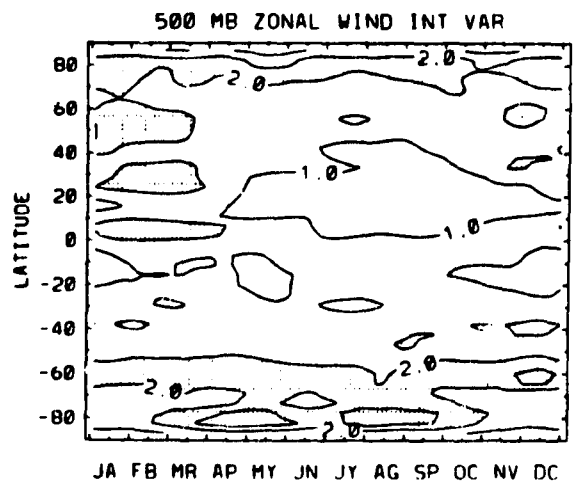
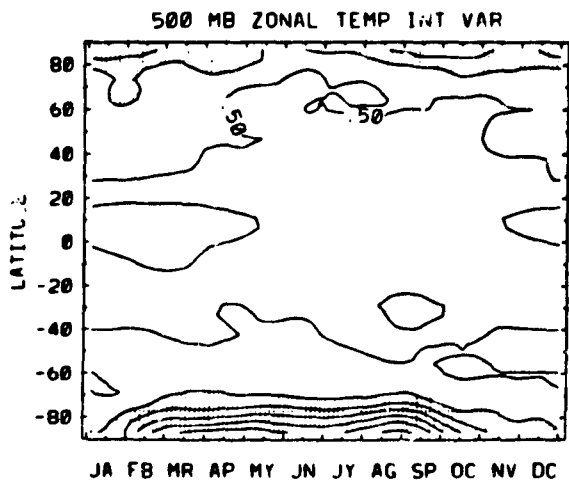
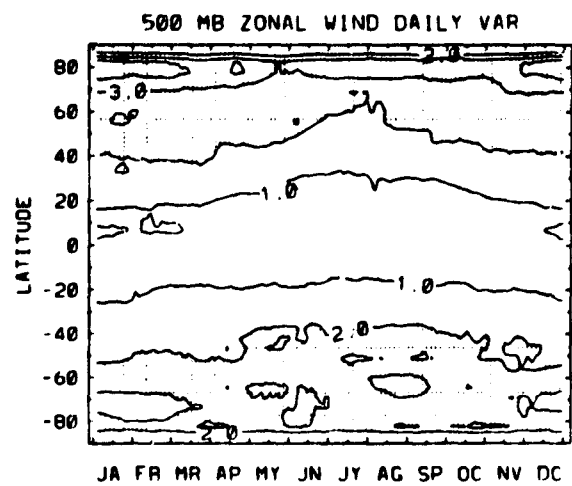
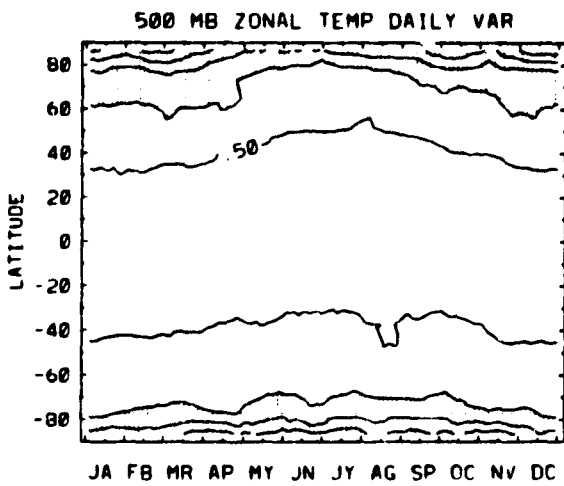
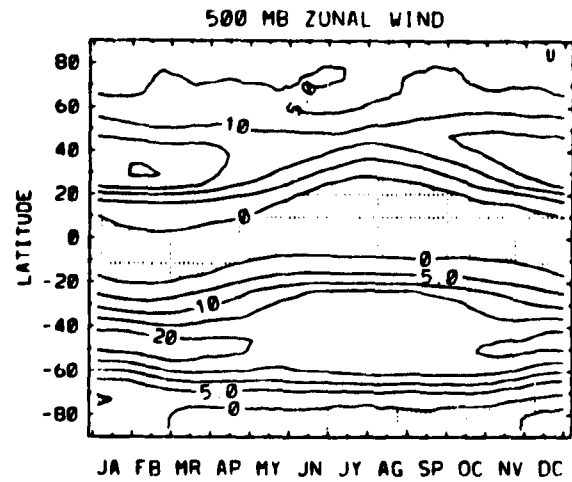
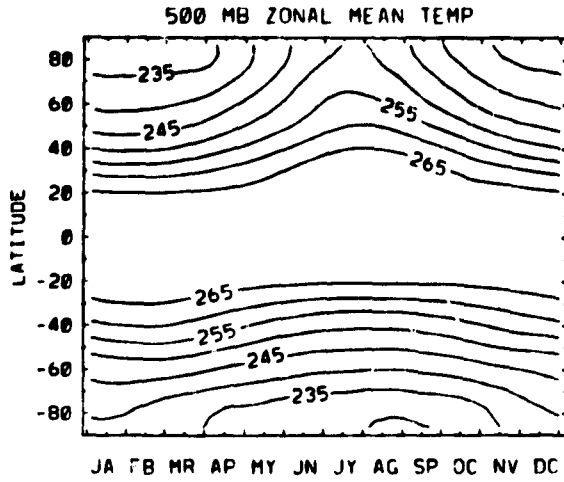
ENSEMBLE AVERAGE LATITUDE-TIME DIAGRAMS

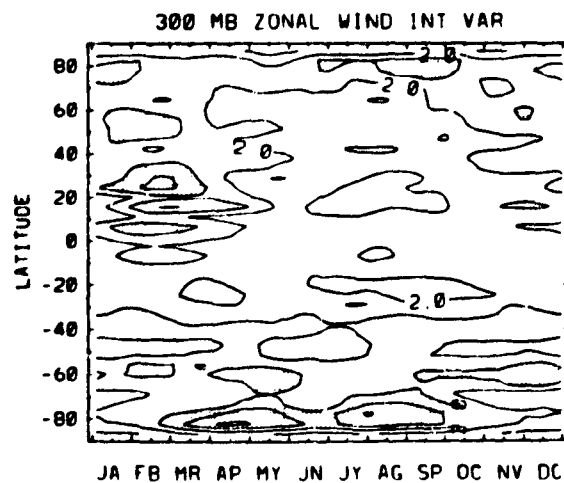
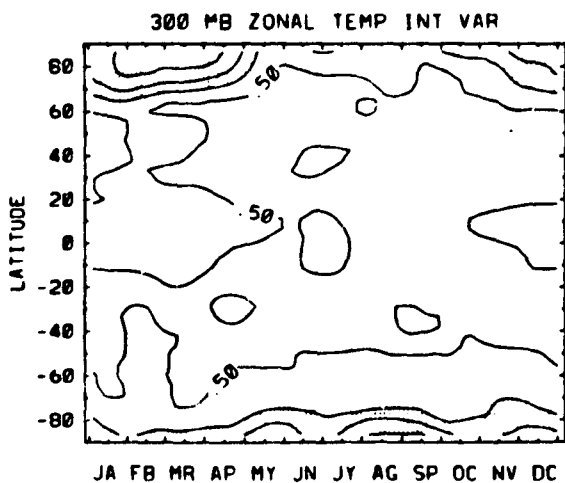
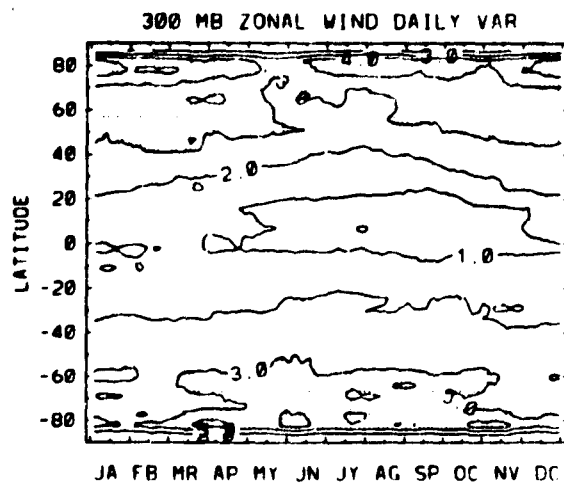
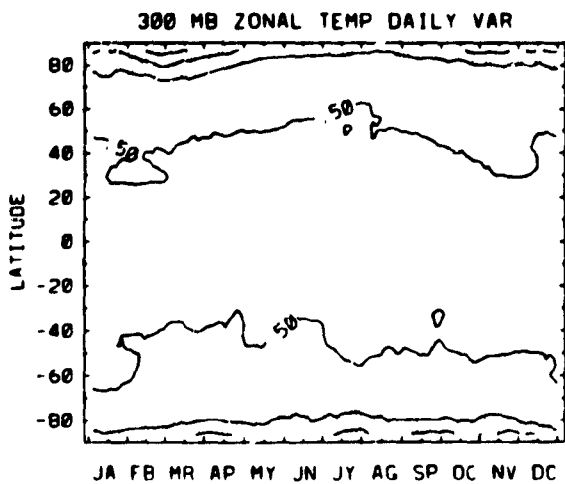
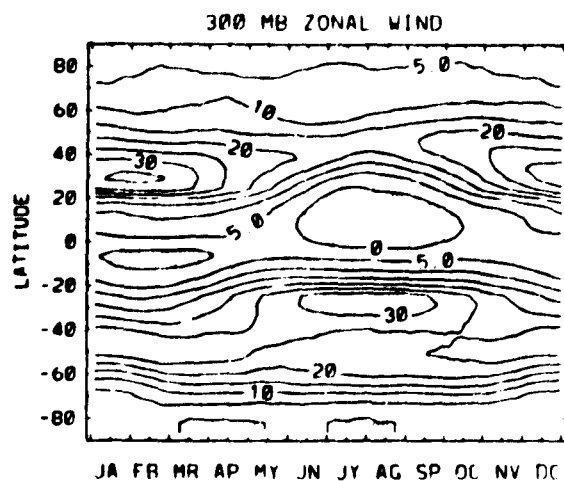
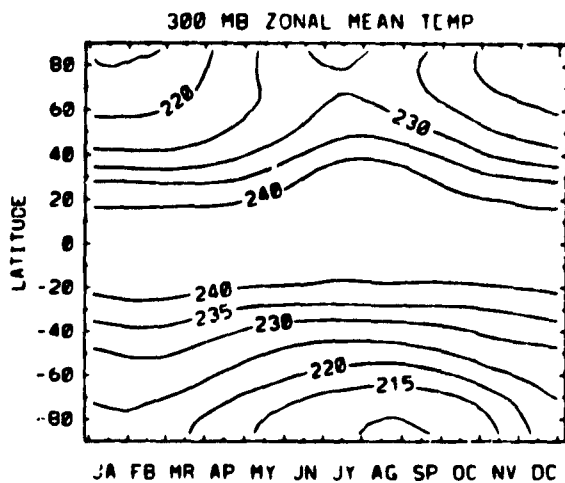
<u>Quantity</u>	<u>Units</u>
Zonal mean temperature	(K)
Zonal mean winds	(m/s)
Zonal mean temperature daily variability (Eq. 20)	(K)
Zonal mean wind daily variability (Eq. 20)	(m/s)
Zonal mean temperature interannual variability (Eq. 21)	(K)
Zonal mean wind interannual variability (Eq. 21)	(m/s)
Meridional vorticity gradient (\bar{q}_y – Eq. 6)	$10^{-11} \text{ m}^{-1} \text{ s}^{-1}$
RMS stationary and transient wave geopotential height wave amplitudes (Eqns. 22-24)	(m)
RMS stationary and transient temperature wave amplitudes (Eqns. 22-24)	(K)
Zonal wave 1-12 poleward heat flux (total, stationary and transient waves)	(K-m/s)
Zonal wave 1-12 poleward momentum flux (total, stationary and transient waves)	(m^2/s^2)
Zonal wave 1-12 EP flux divergence (total, stationary and transient waves)	(m/s per day)

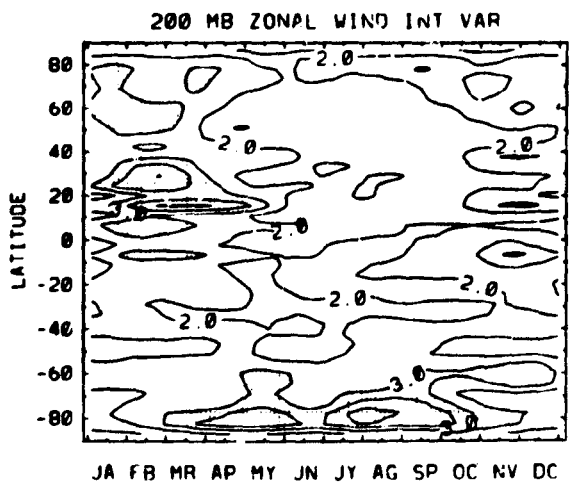
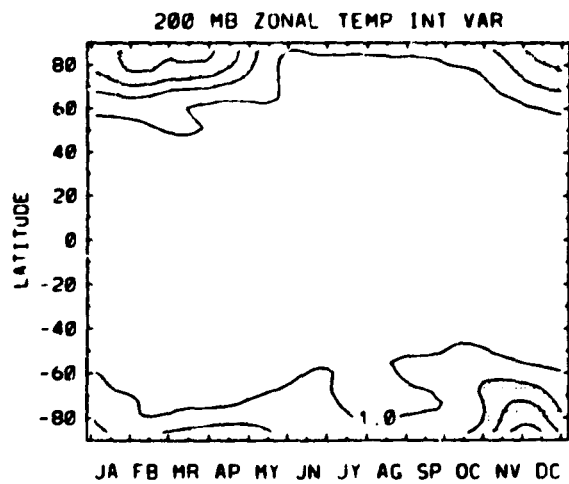
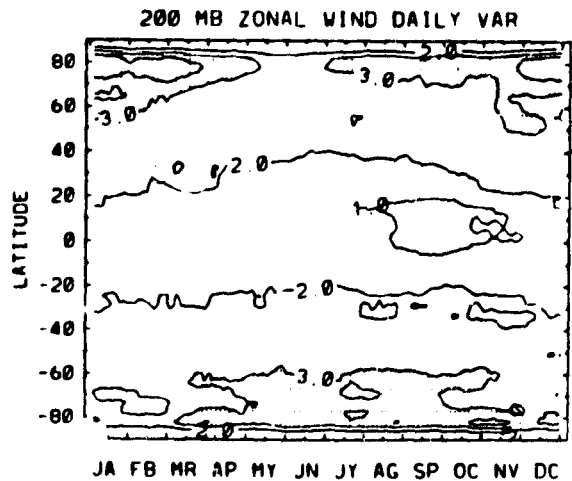
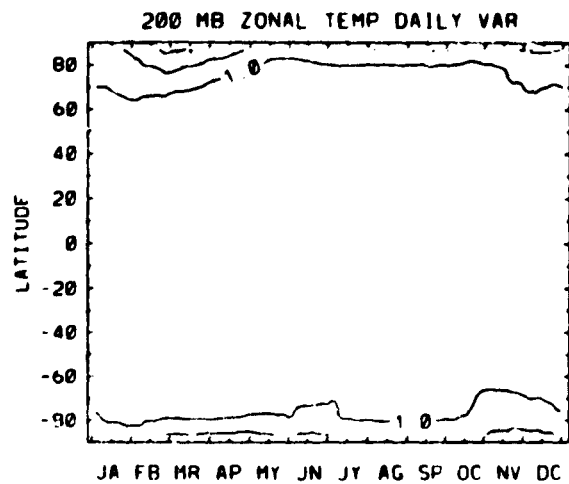
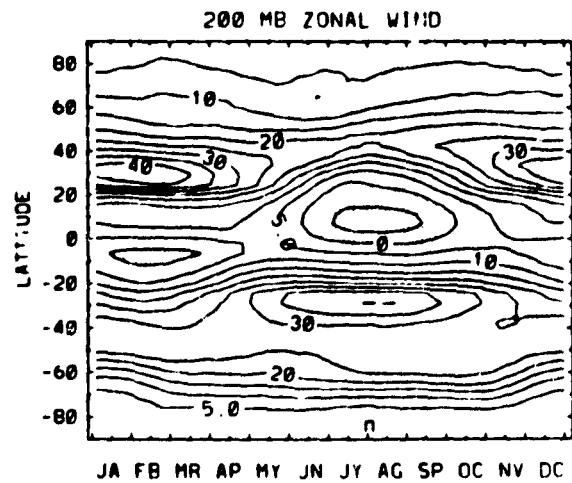
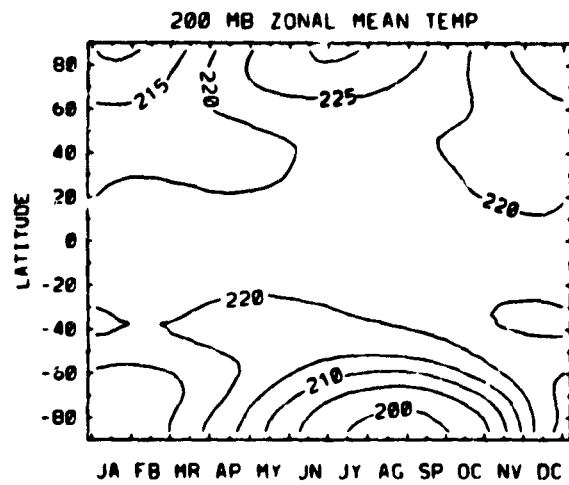
NOTES: Zero contours are omitted in the wave flux diagrams. The sign of the EP flux divergences have been reversed for clarity (solid lines denote negative values).

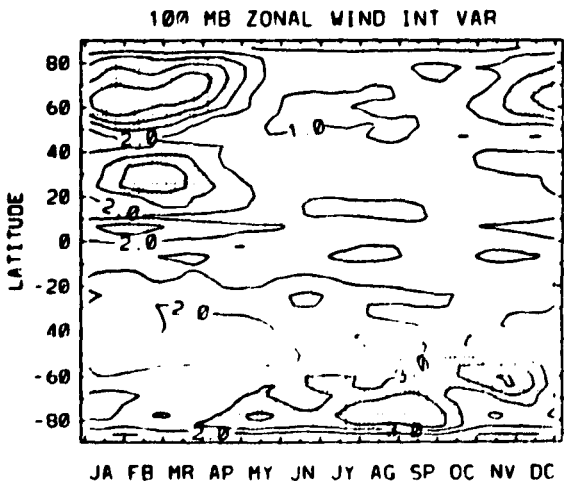
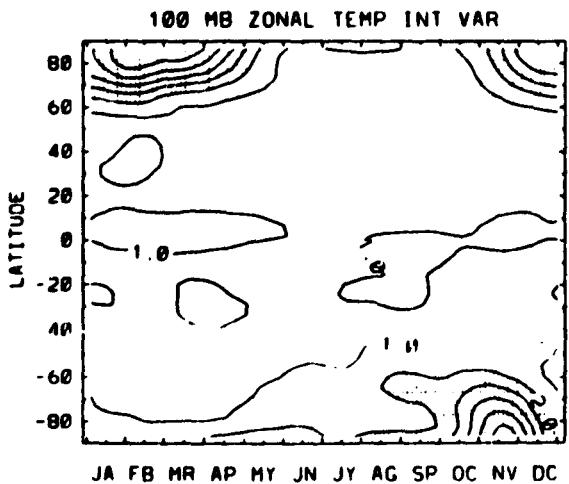
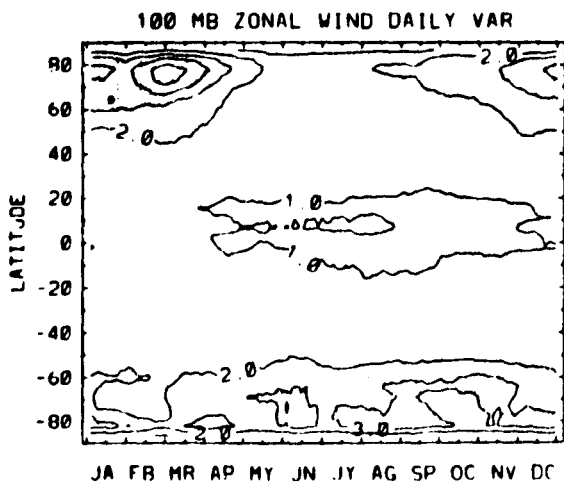
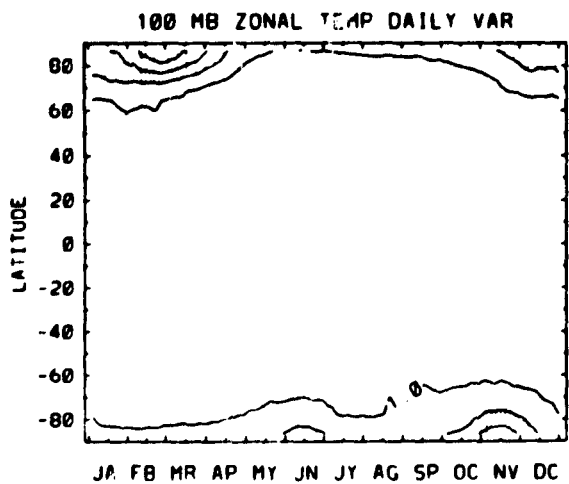
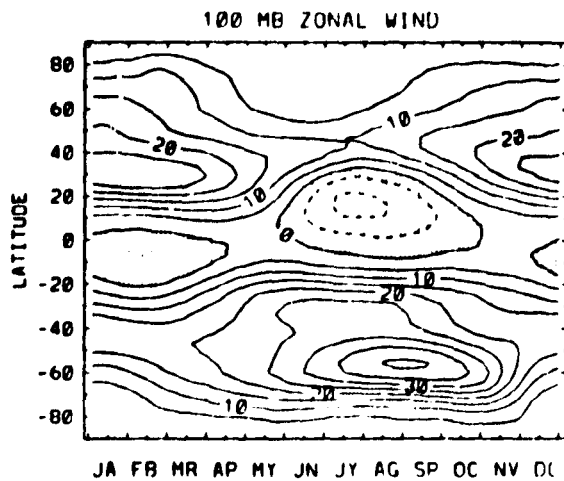
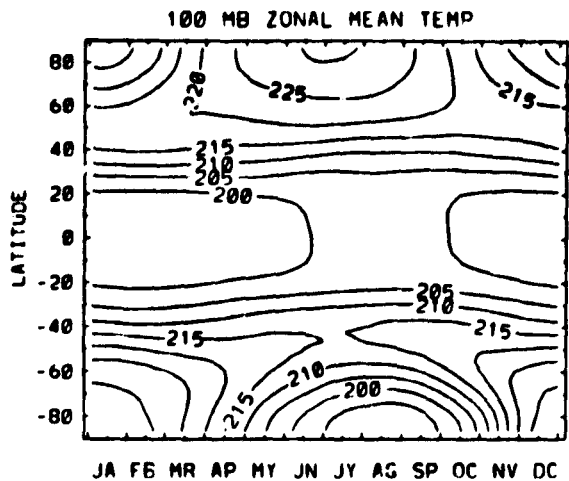
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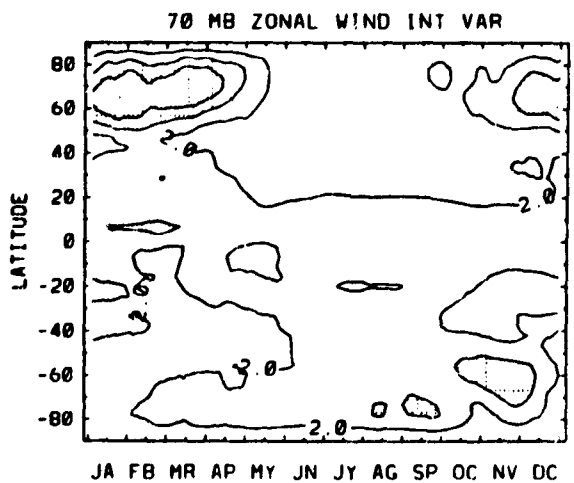
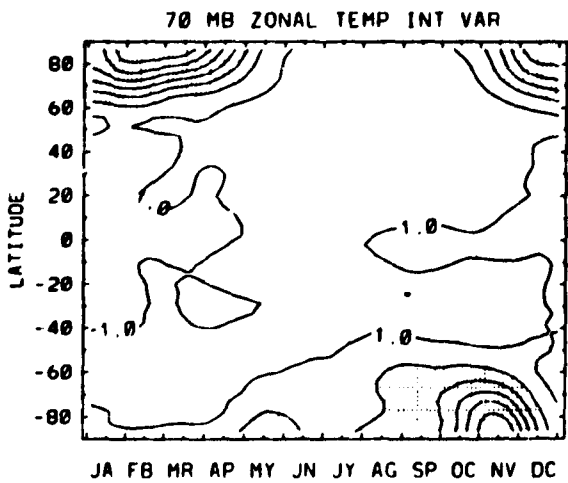
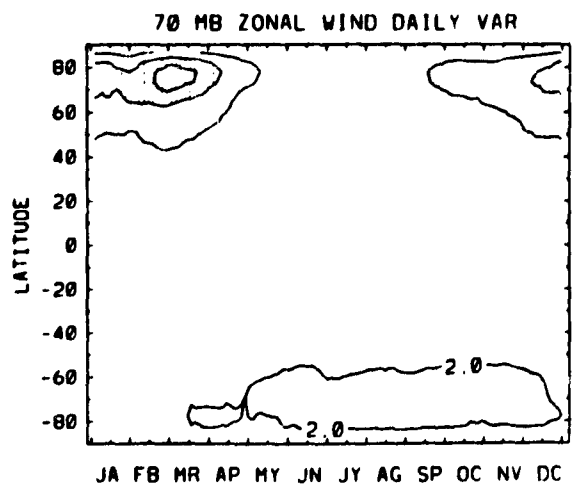
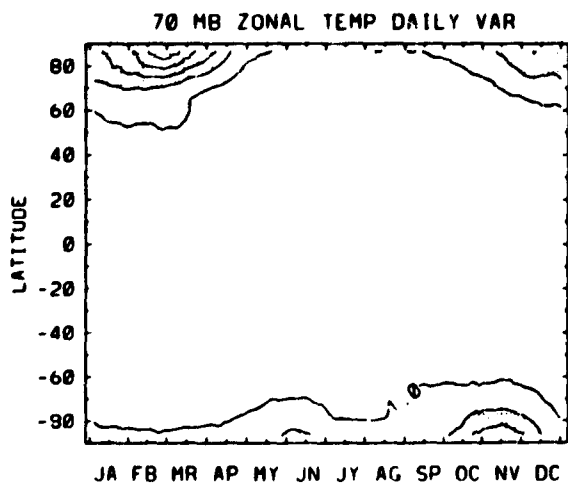
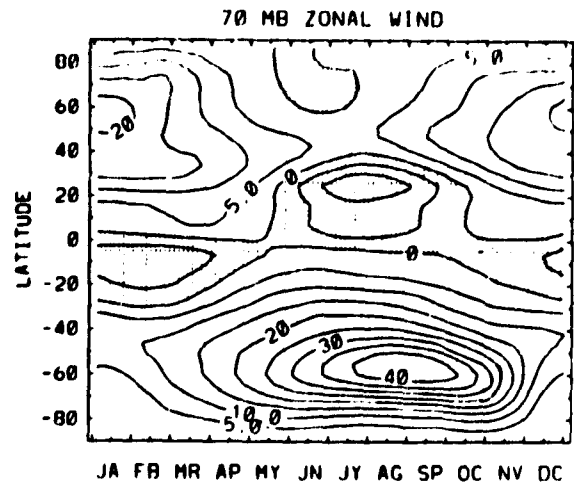
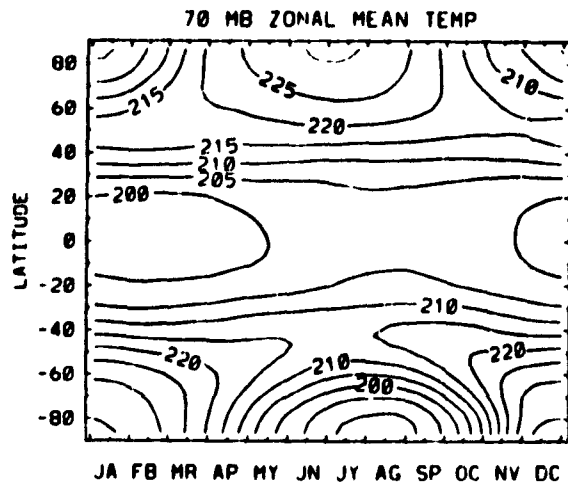


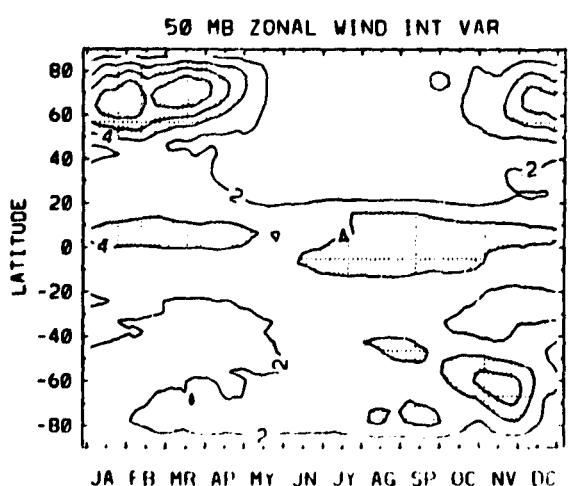
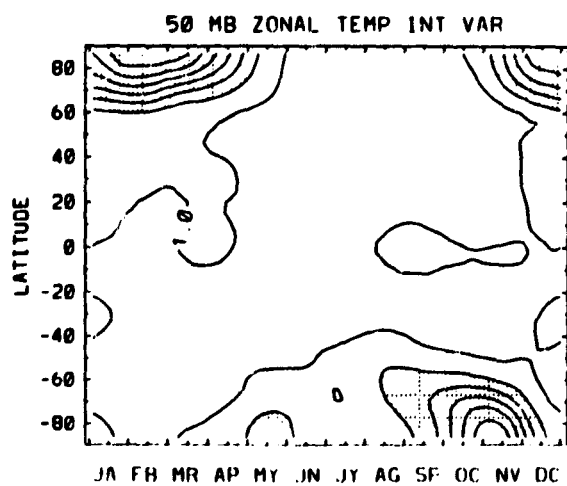
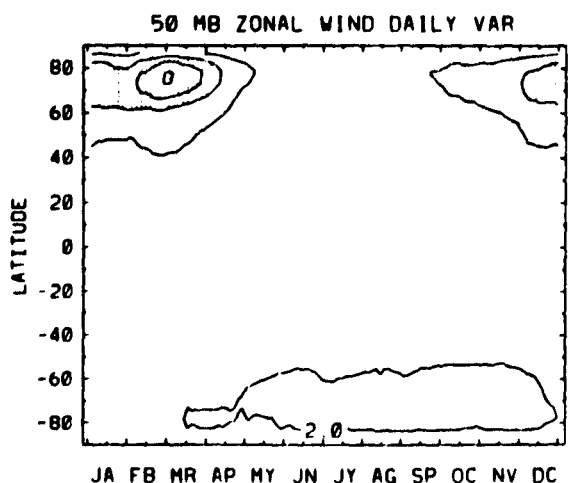
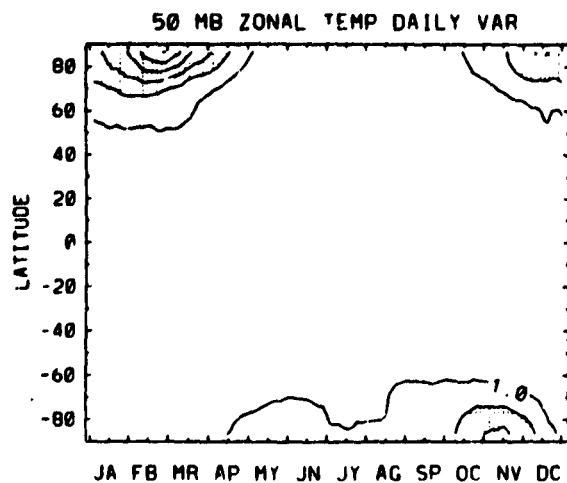
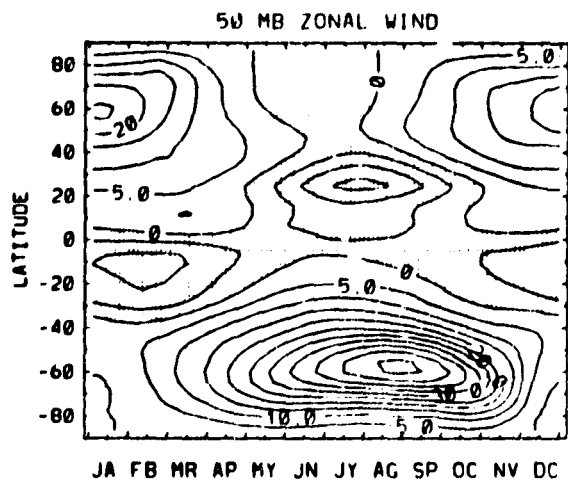
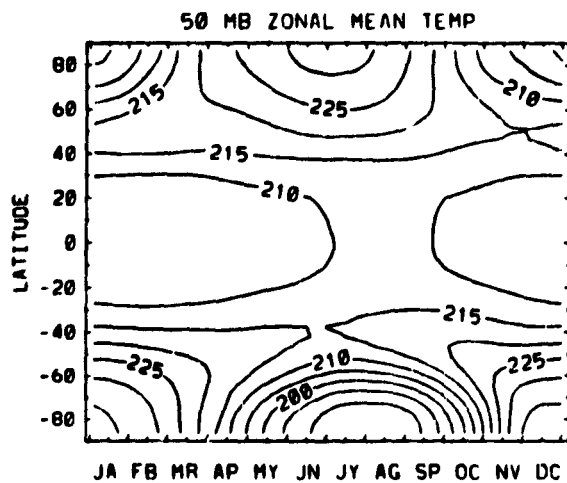


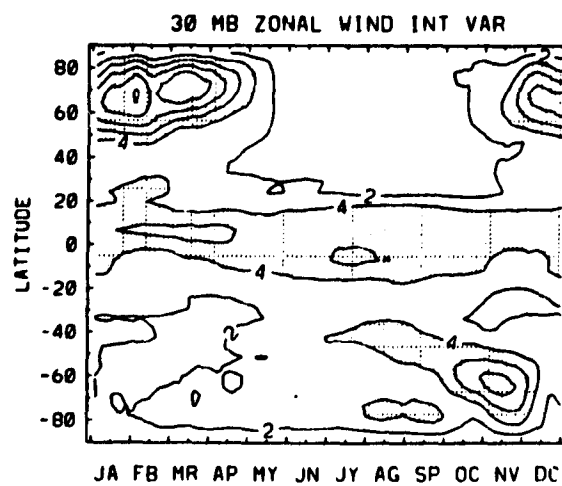
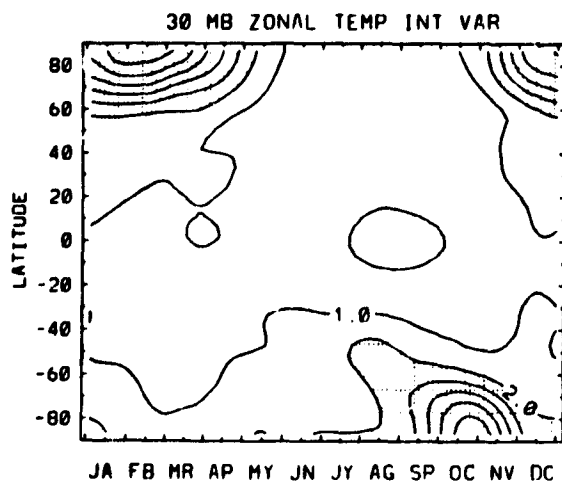
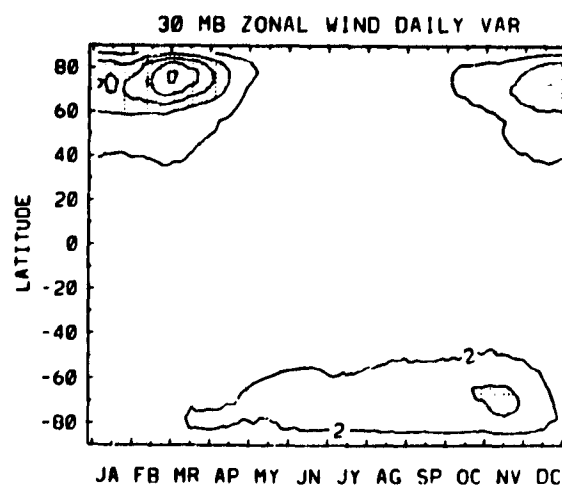
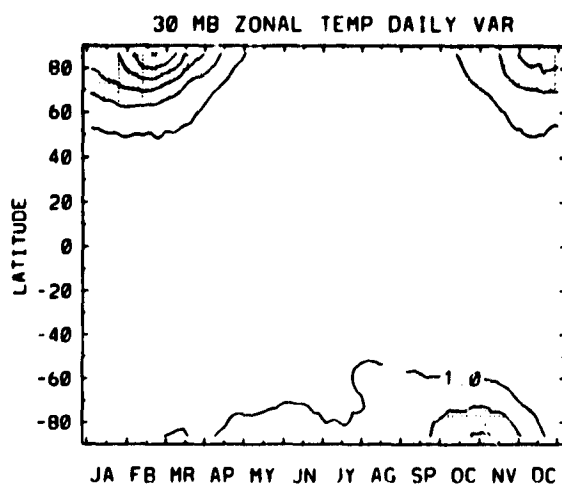
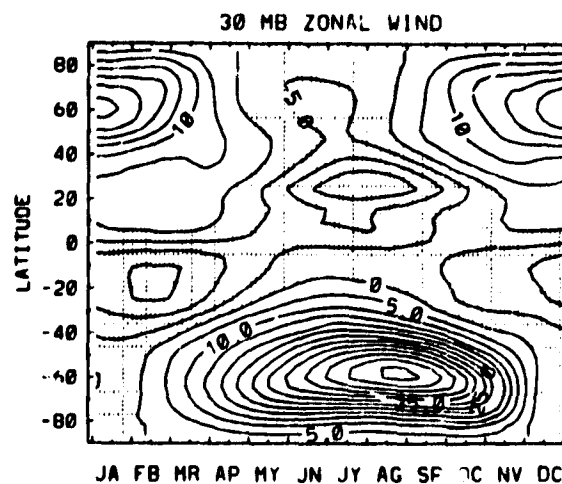
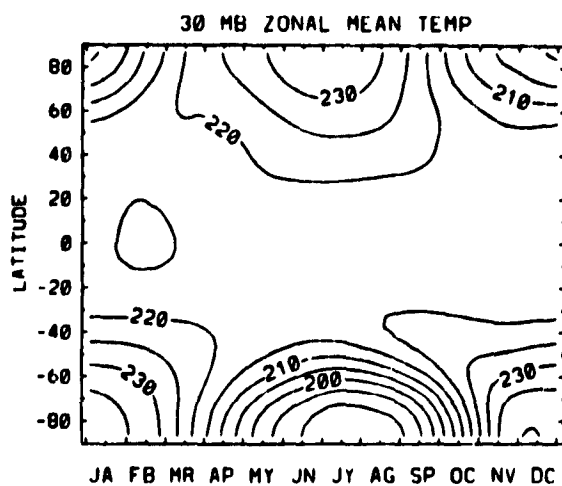


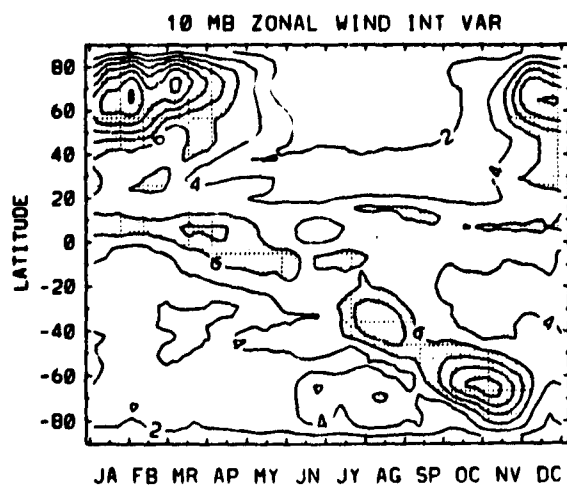
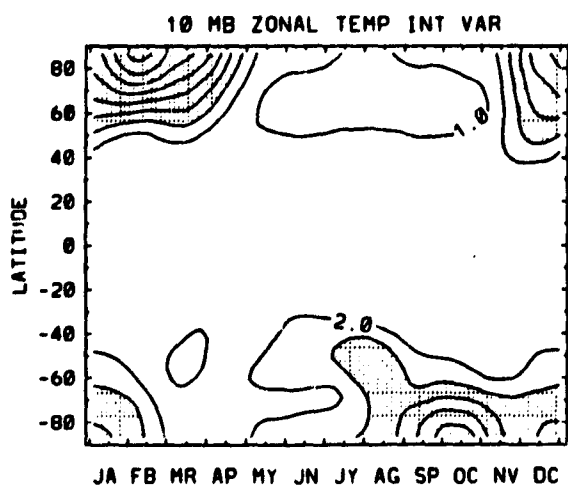
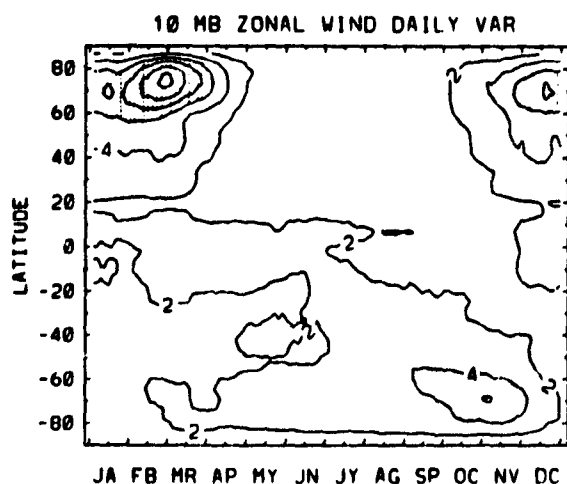
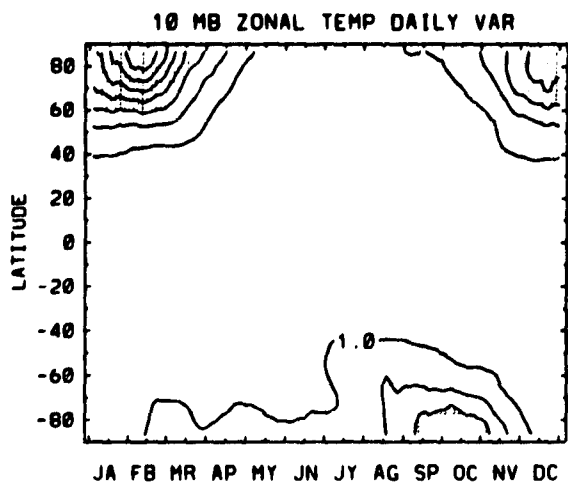
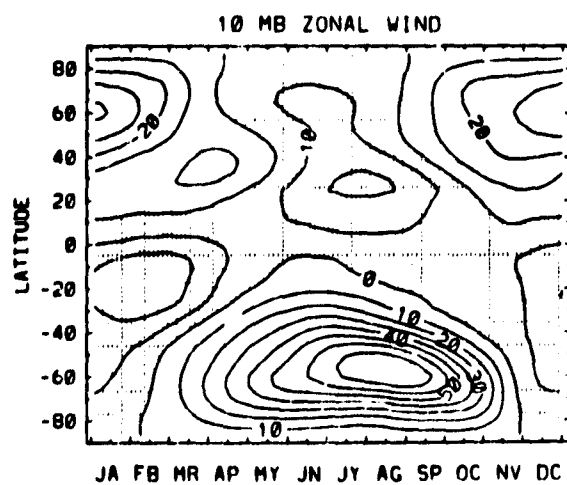
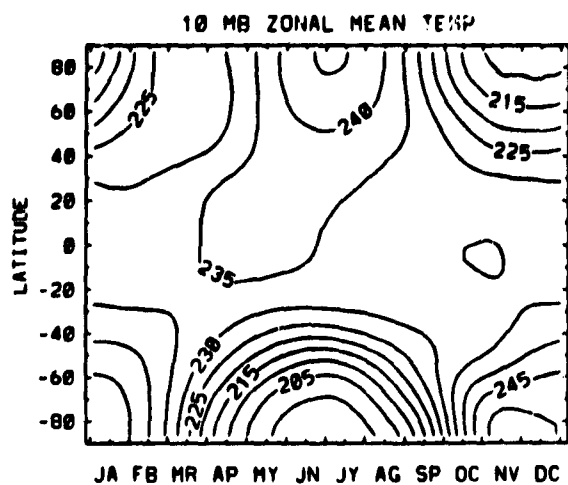


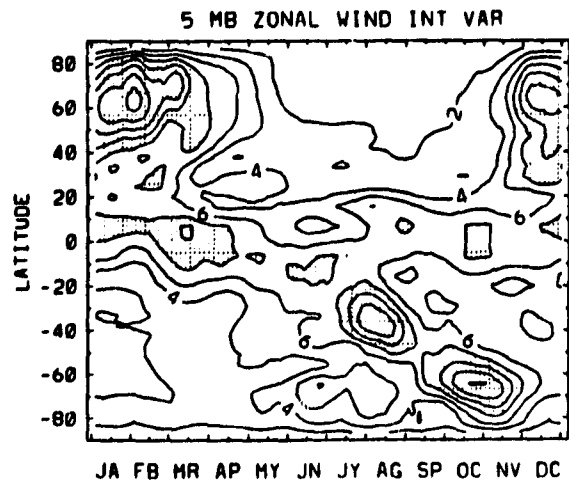
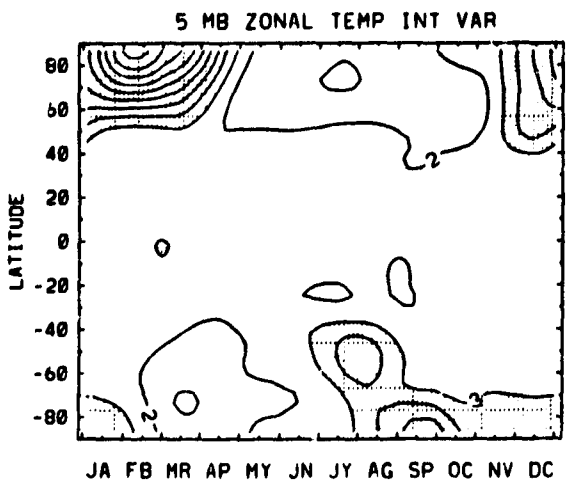
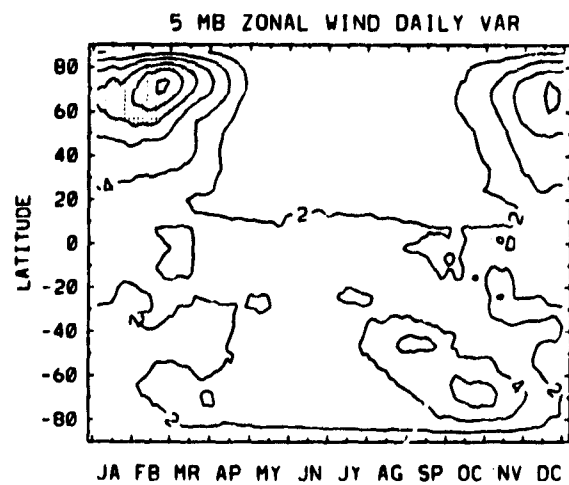
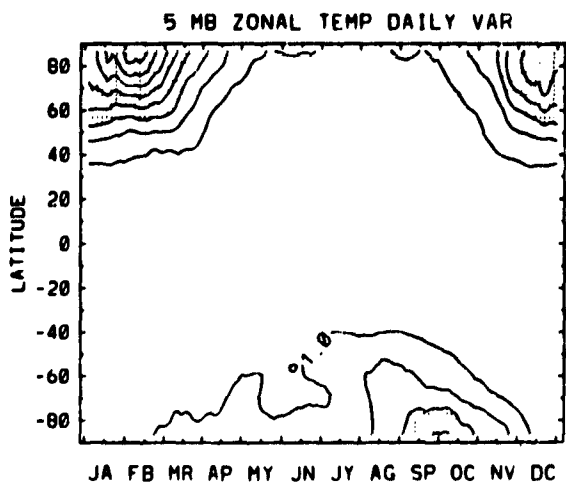
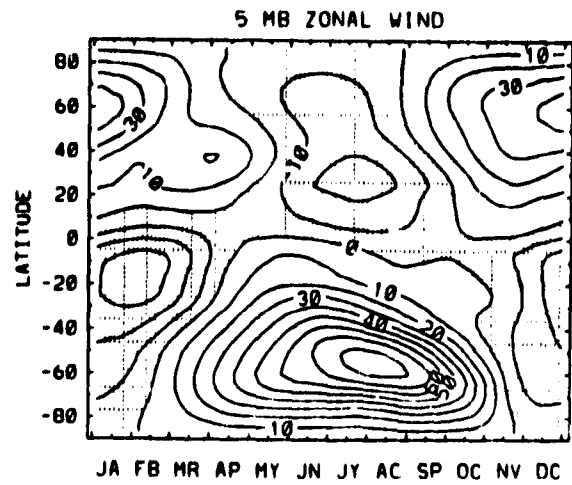
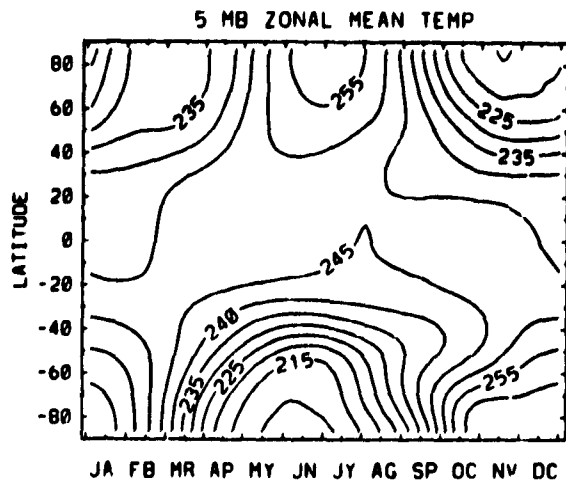


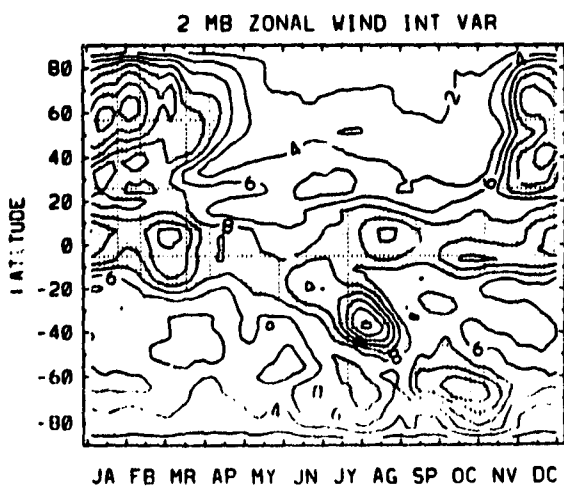
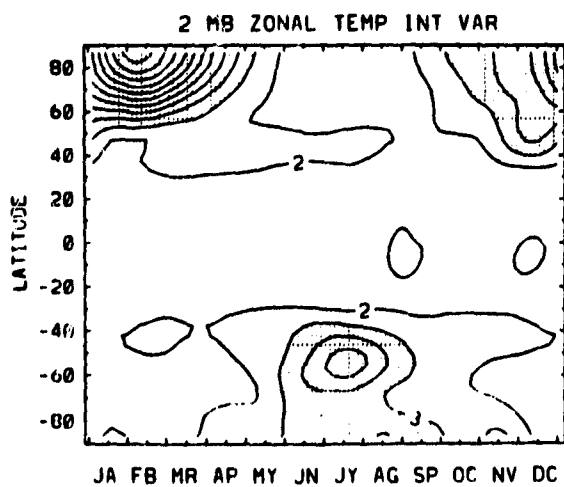
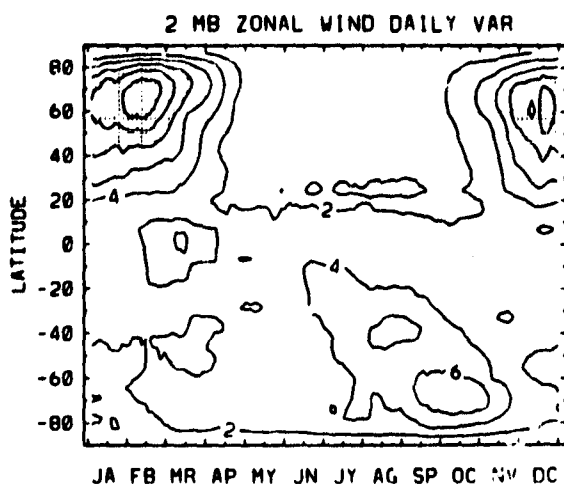
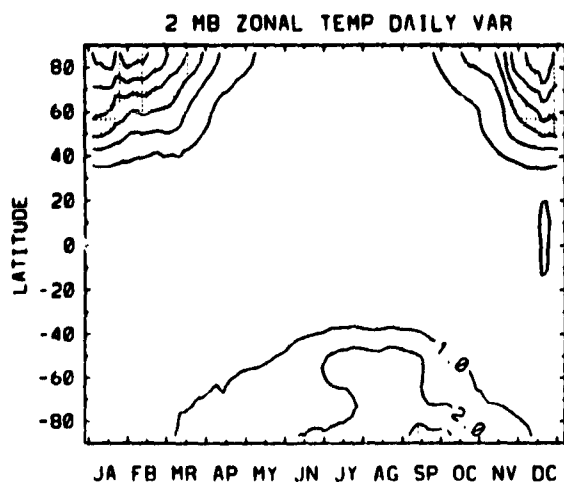
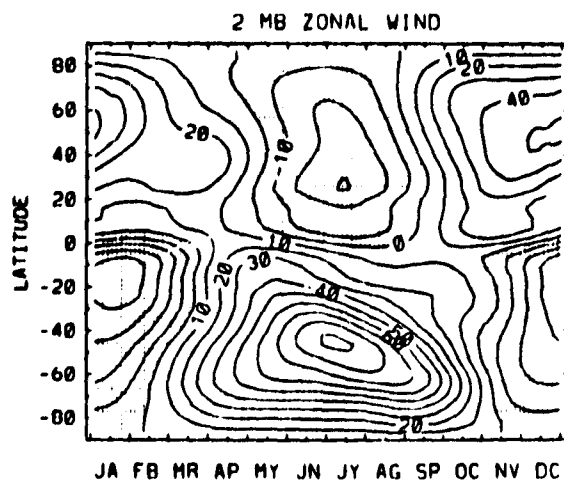
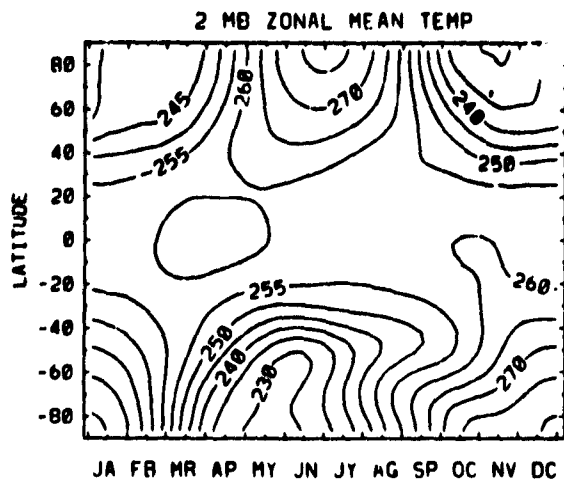


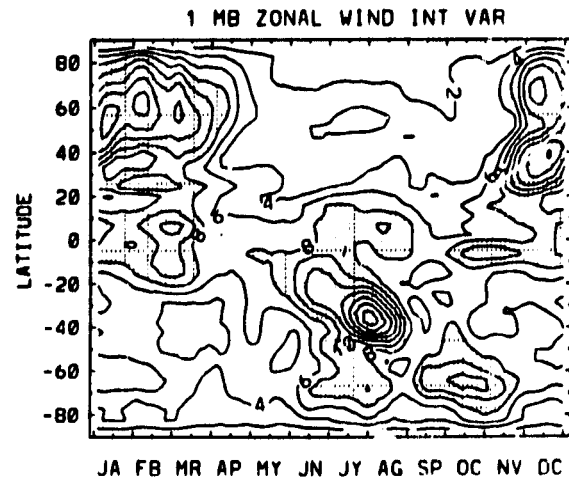
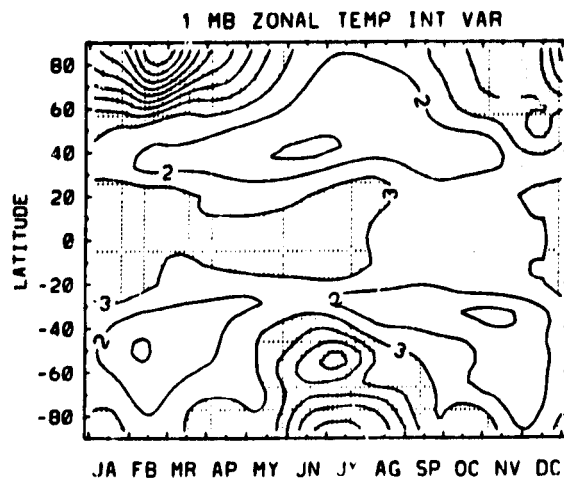
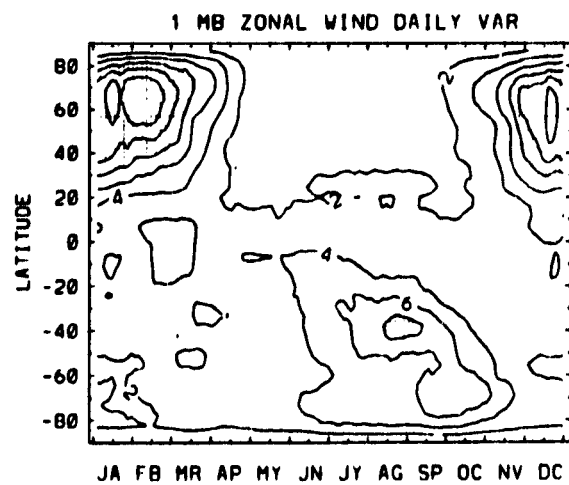
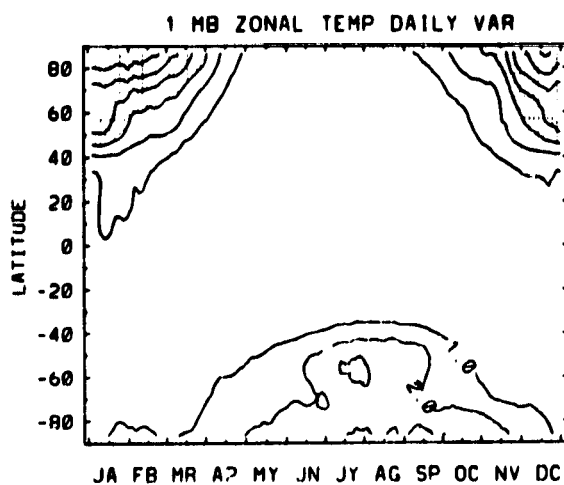
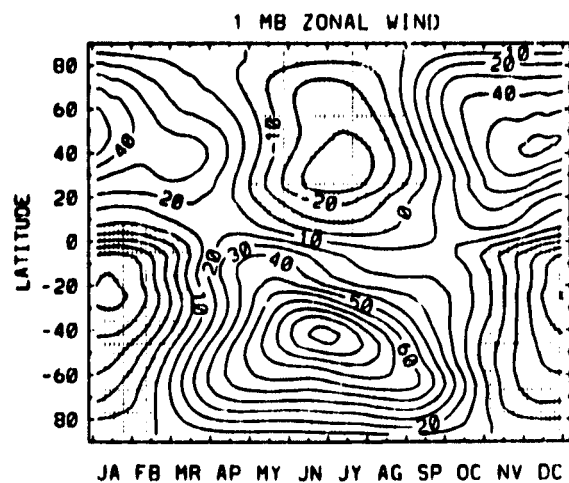
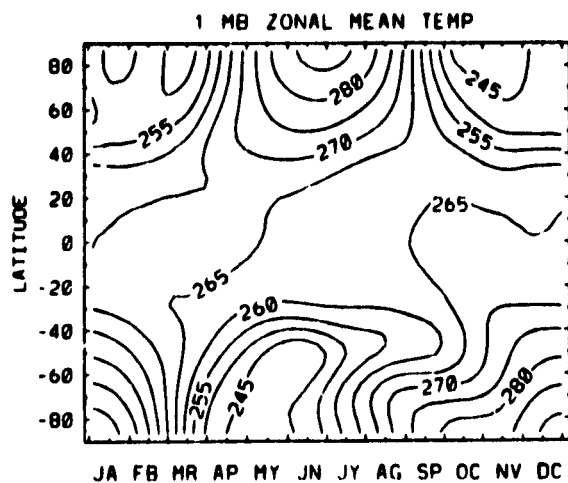


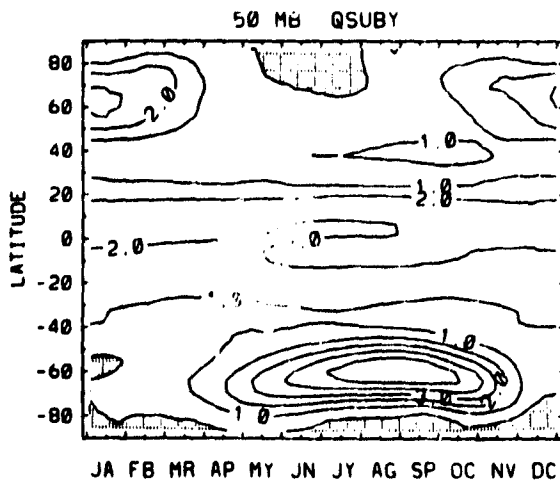
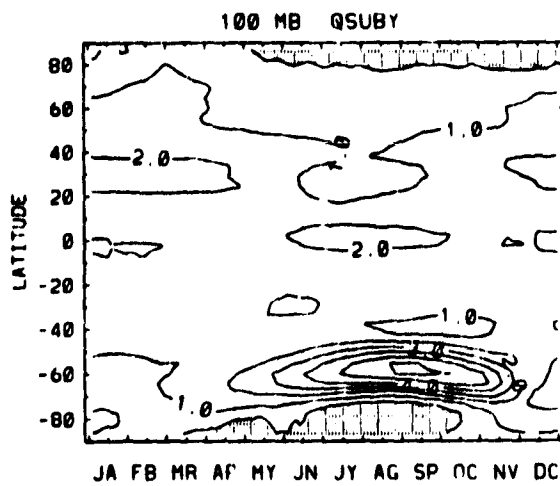
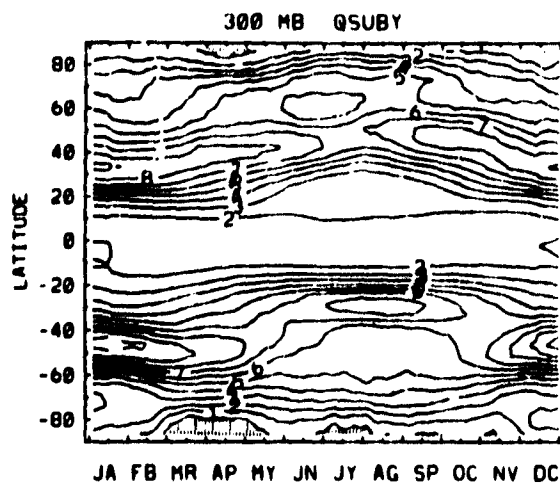


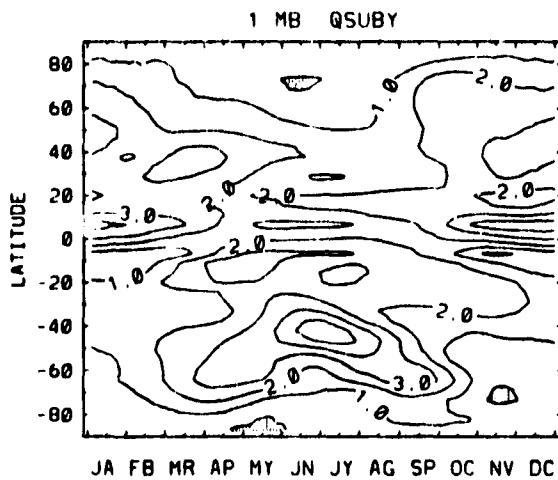
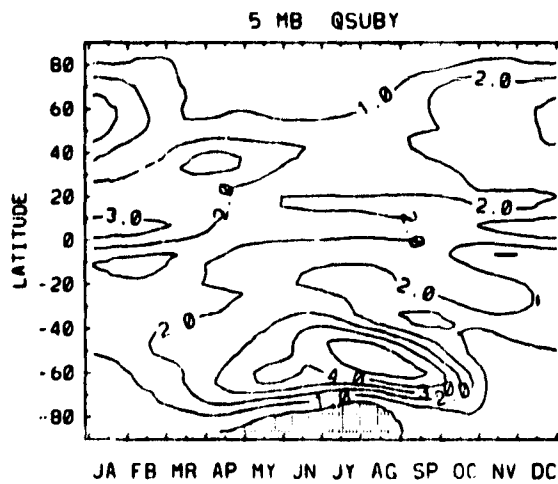
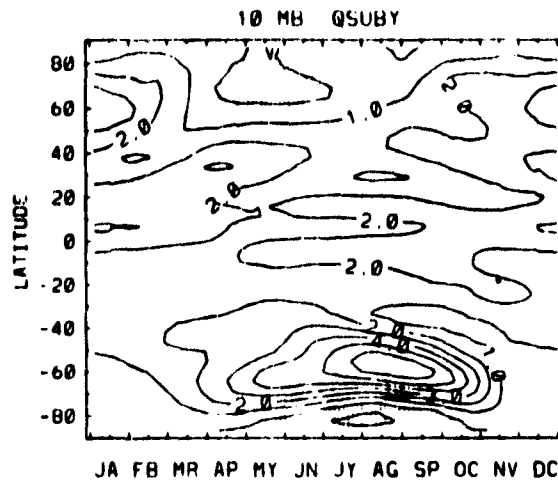


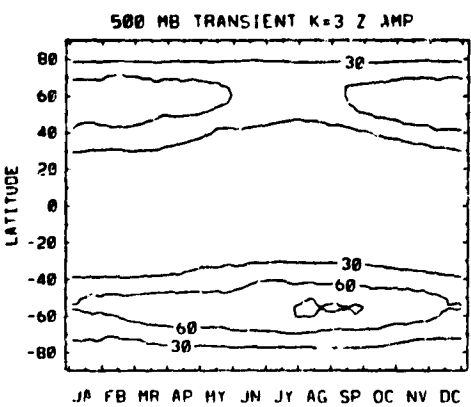
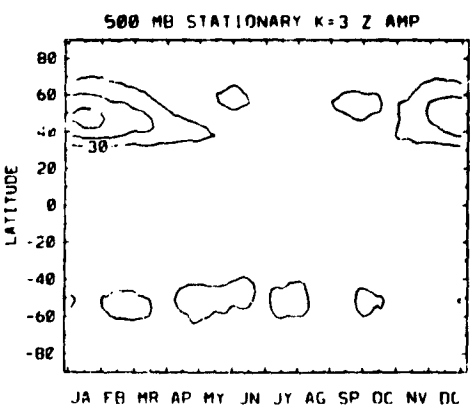
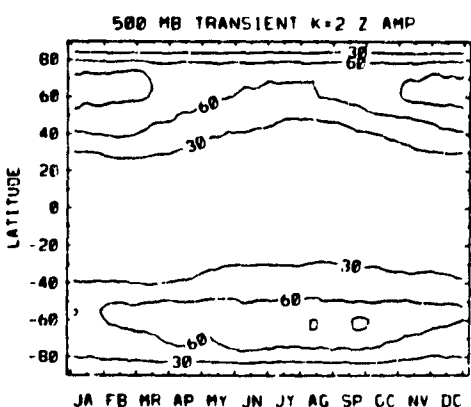
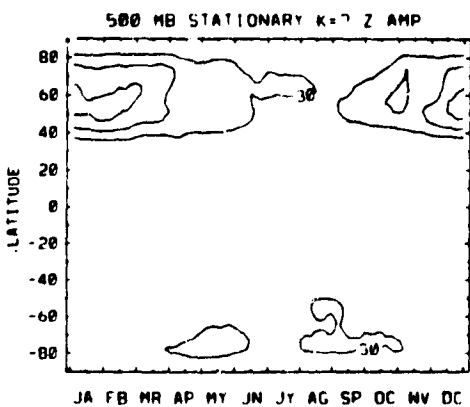
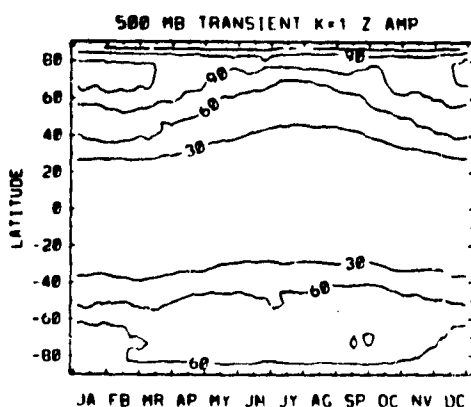
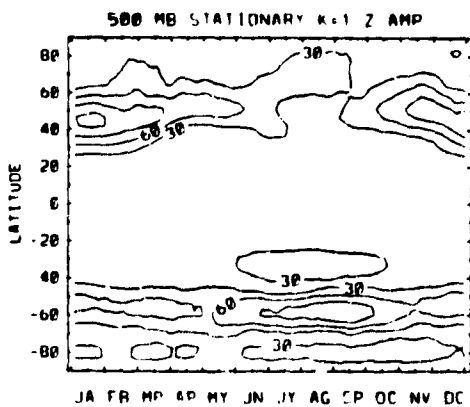
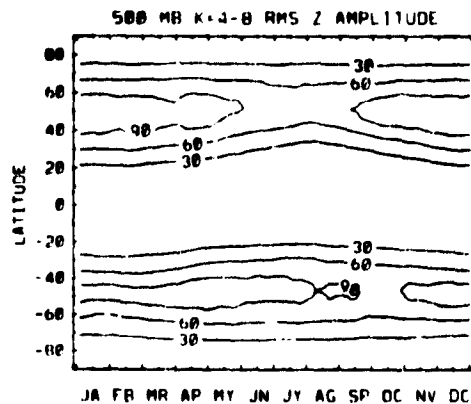
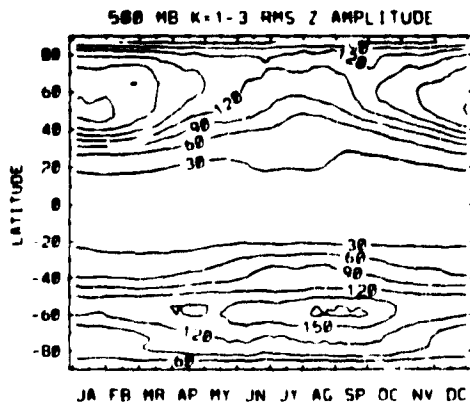


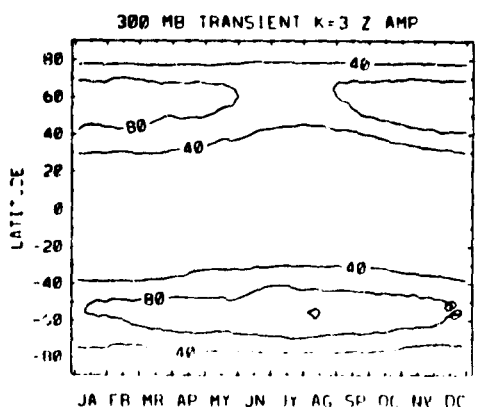
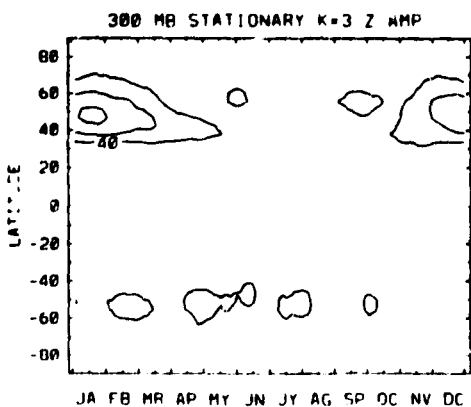
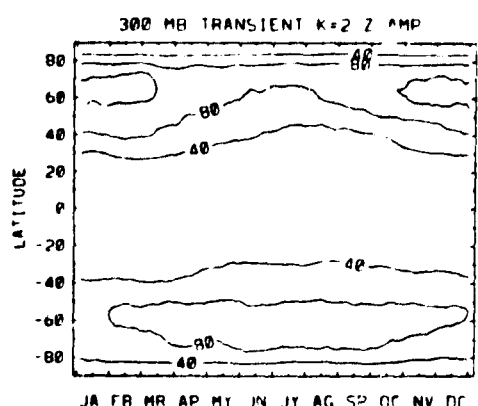
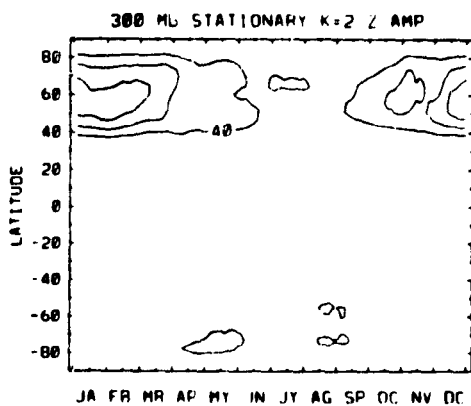
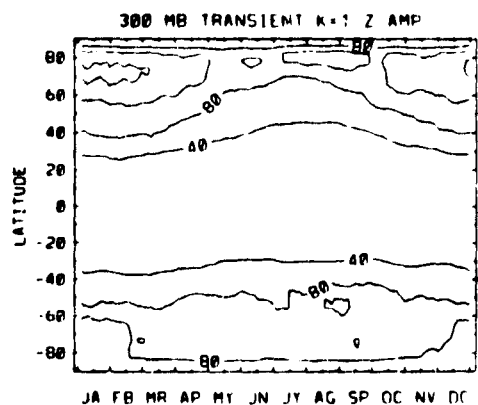
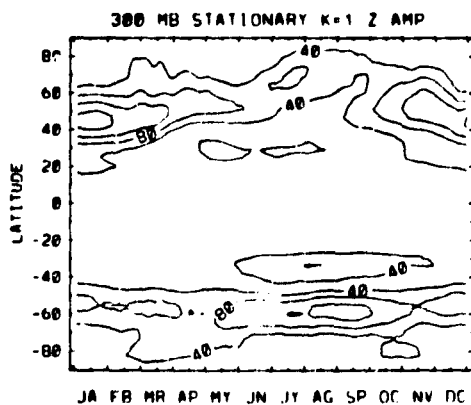
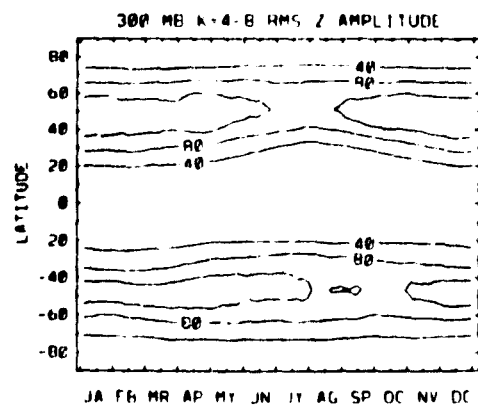
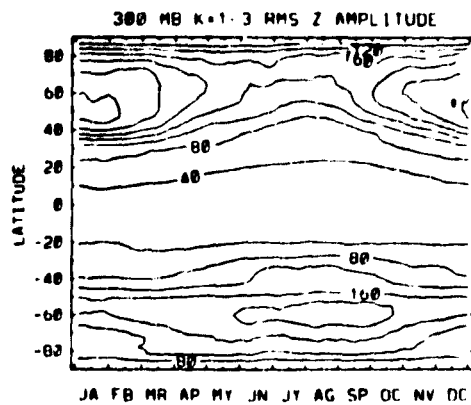


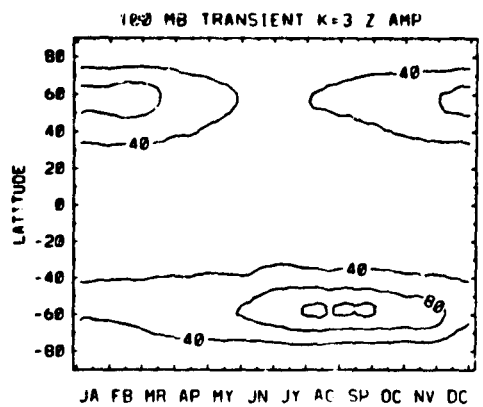
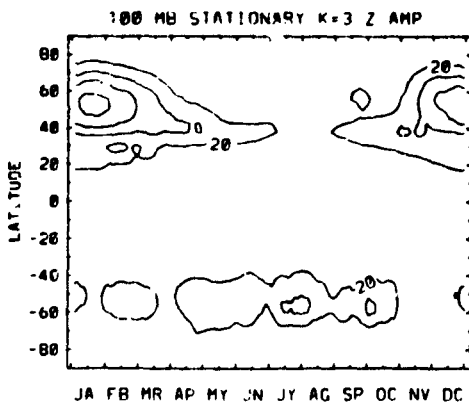
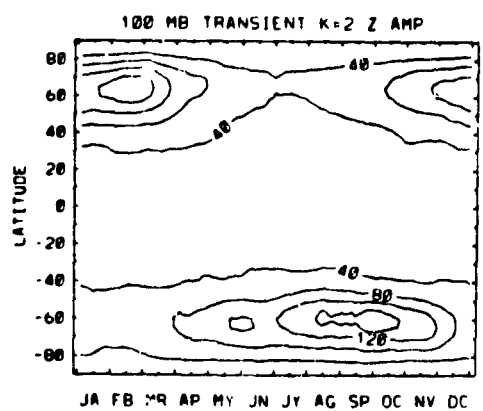
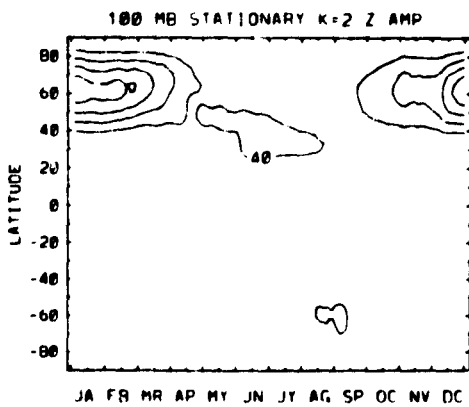
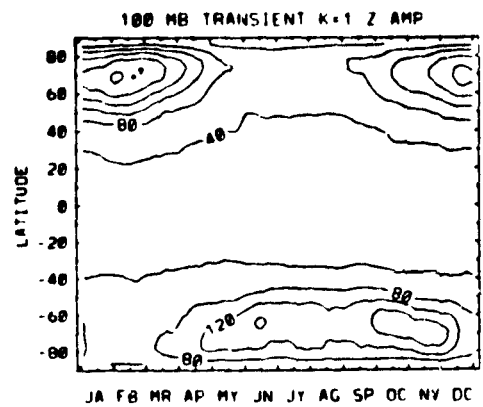
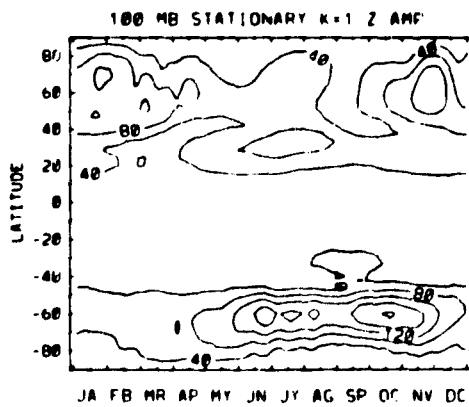
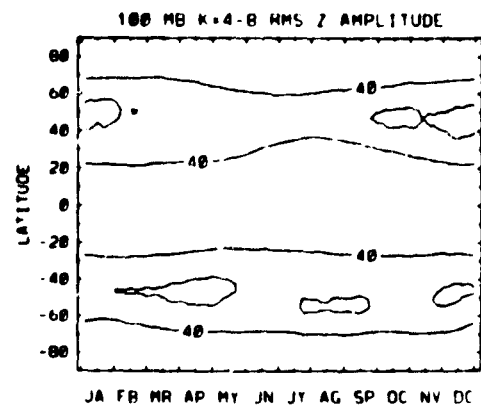
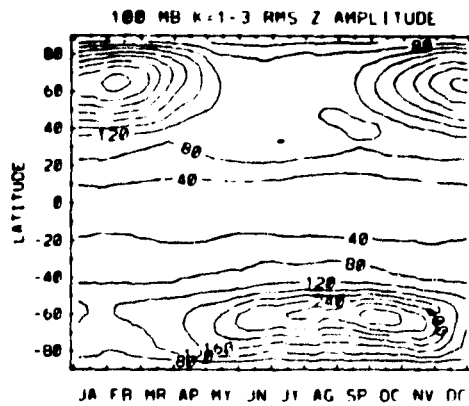


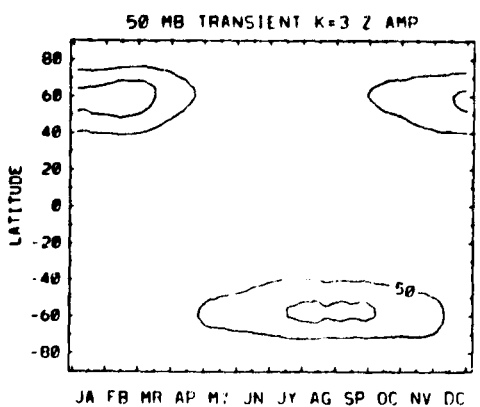
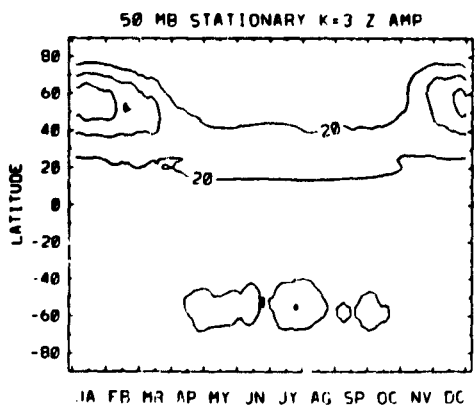
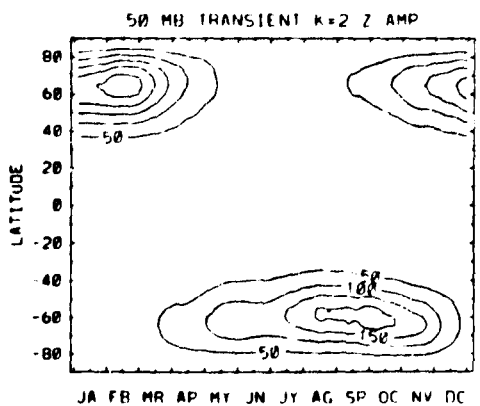
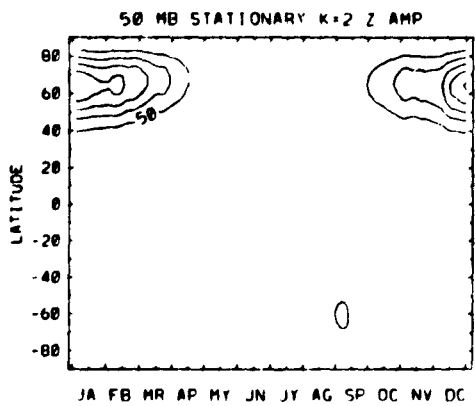
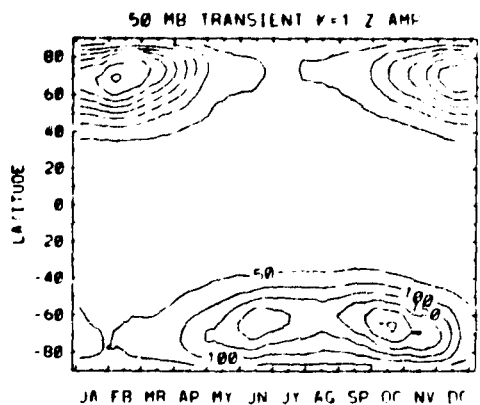
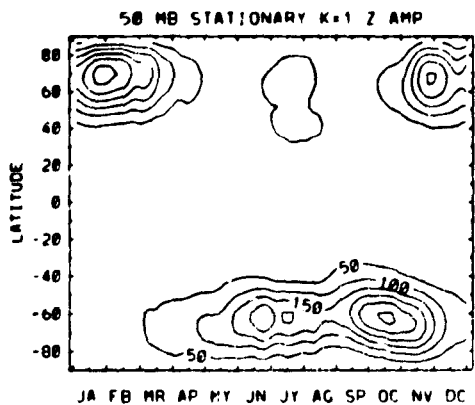
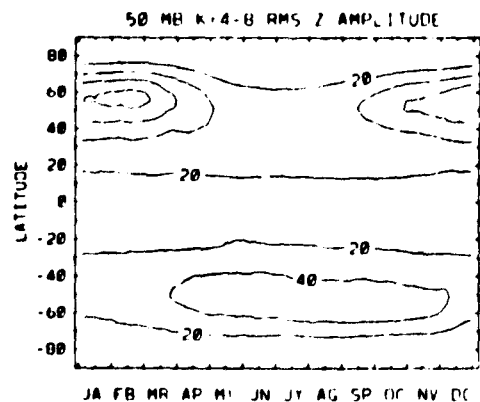
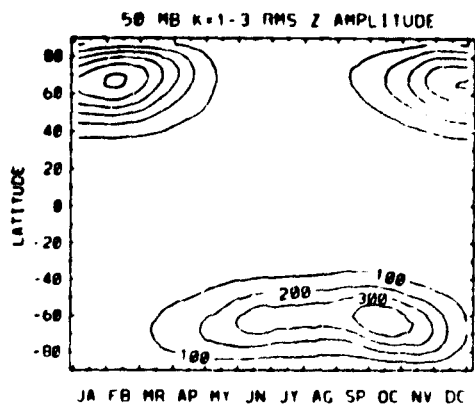


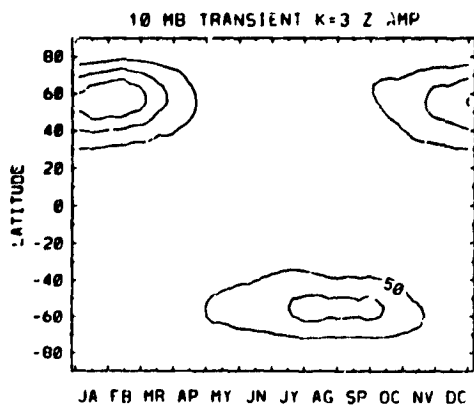
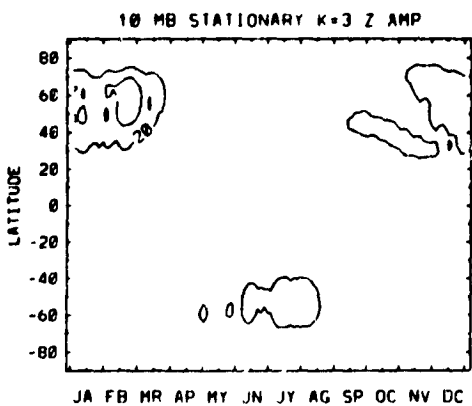
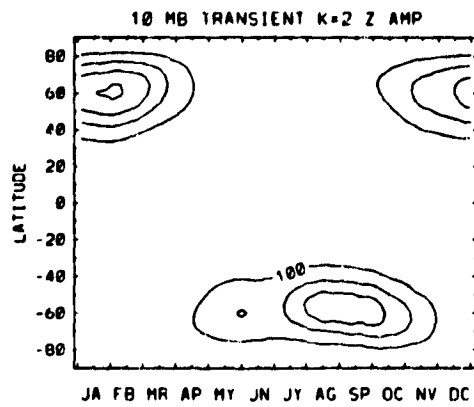
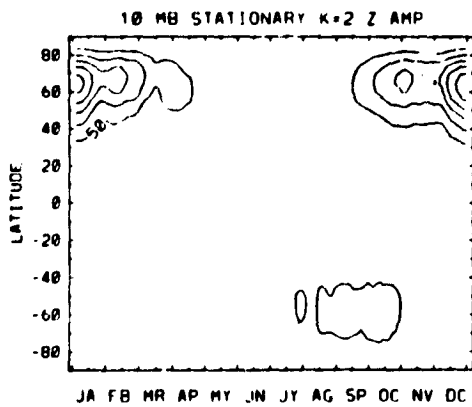
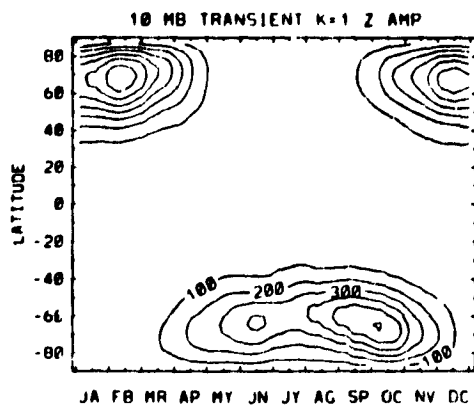
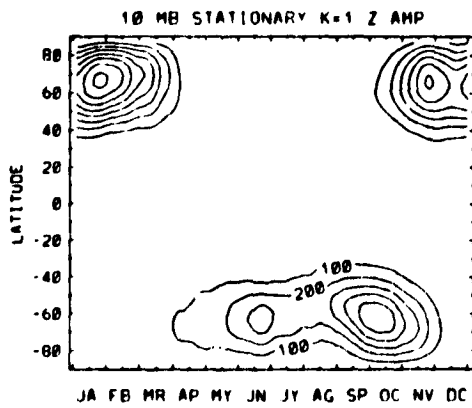
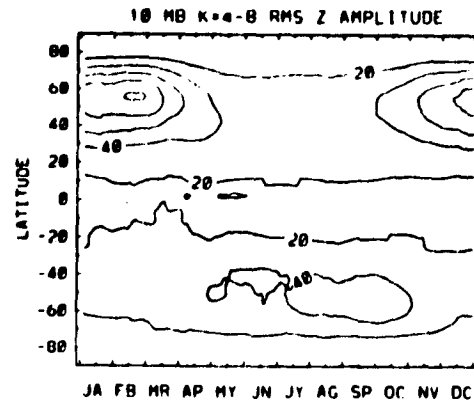
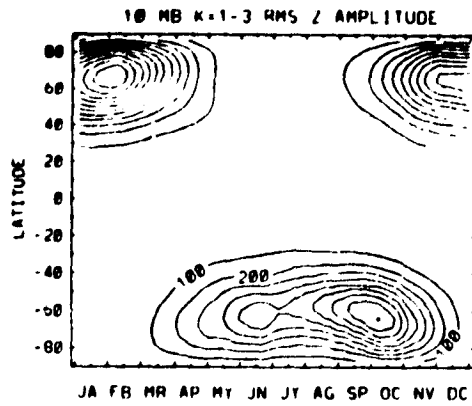


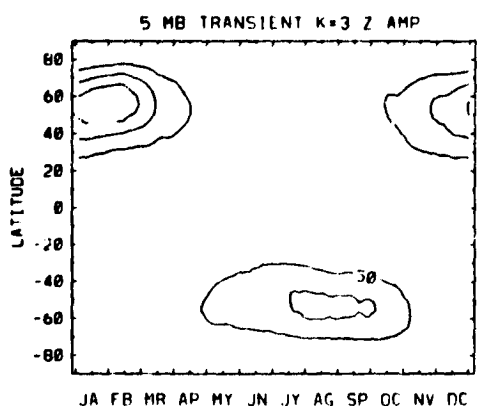
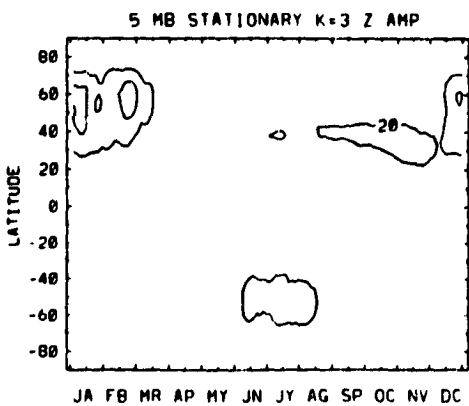
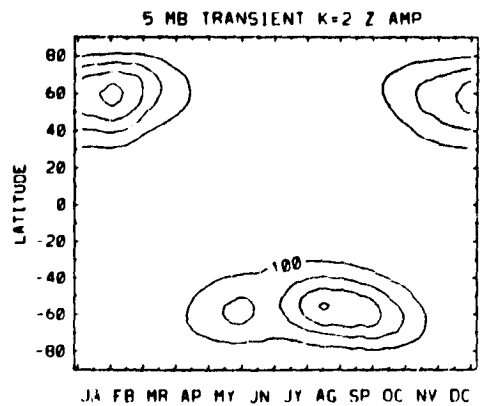
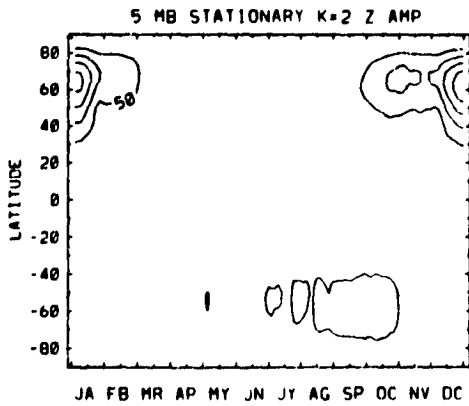
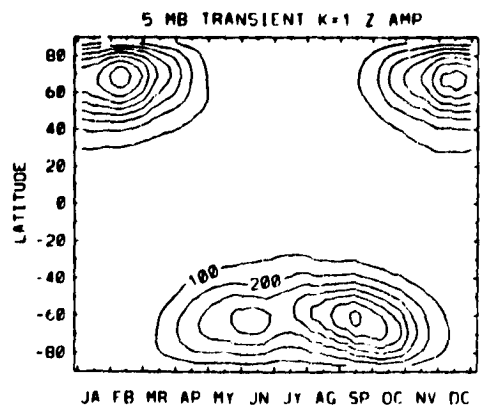
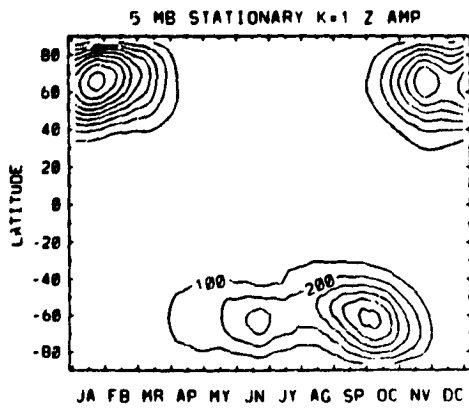
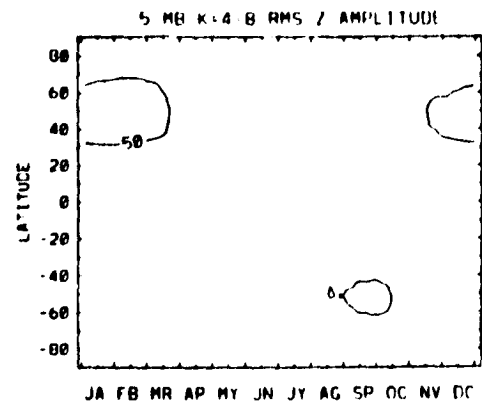
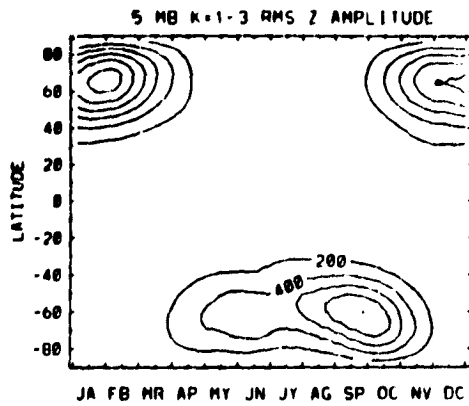


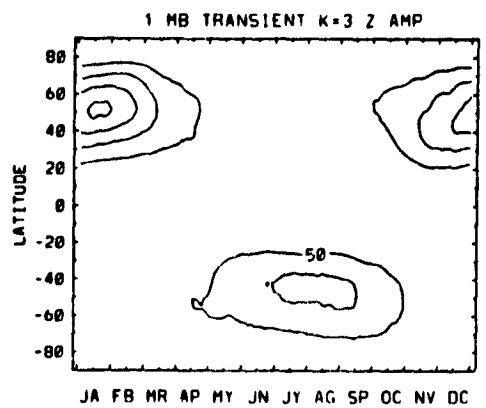
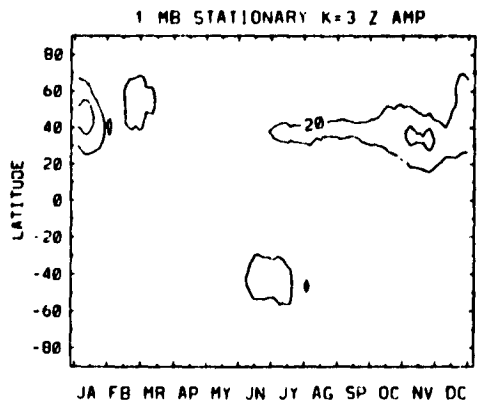
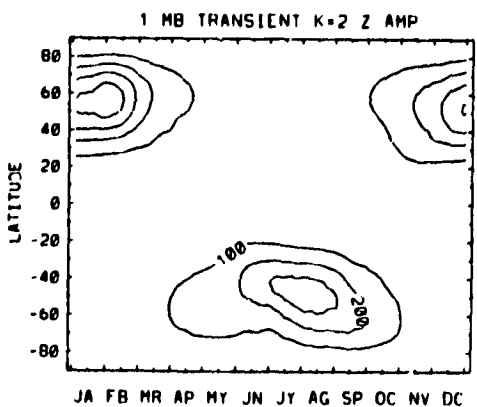
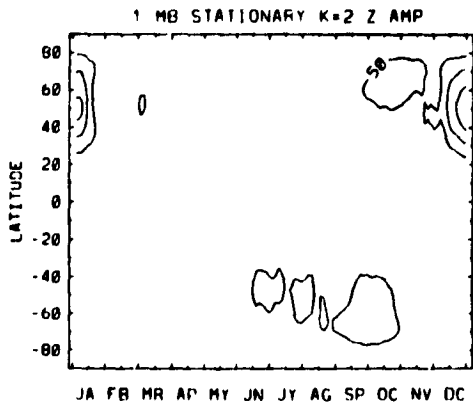
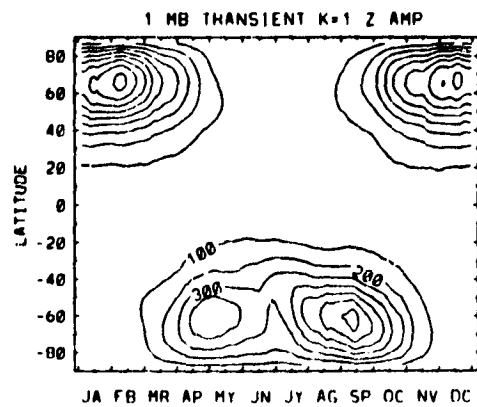
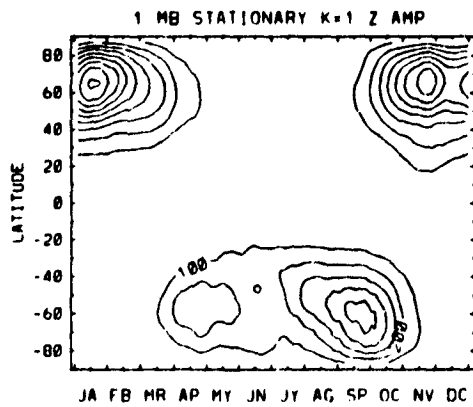
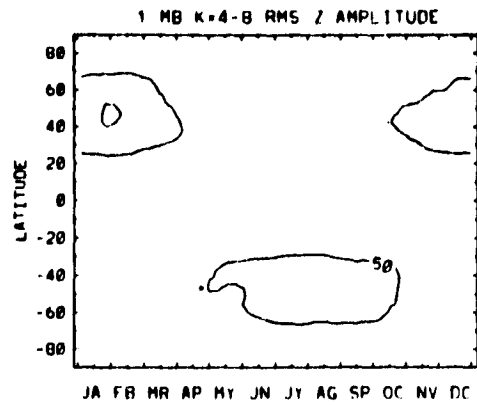
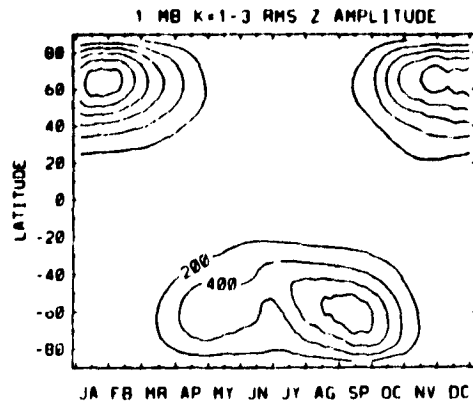


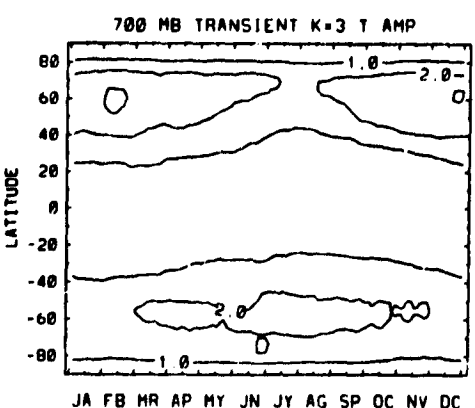
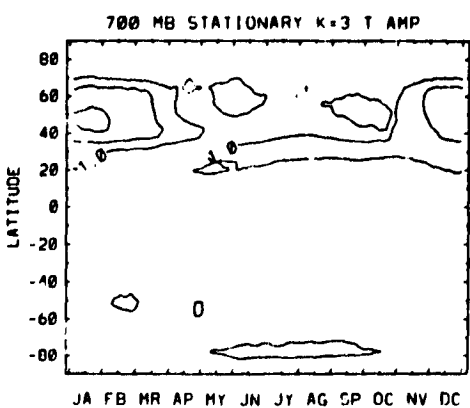
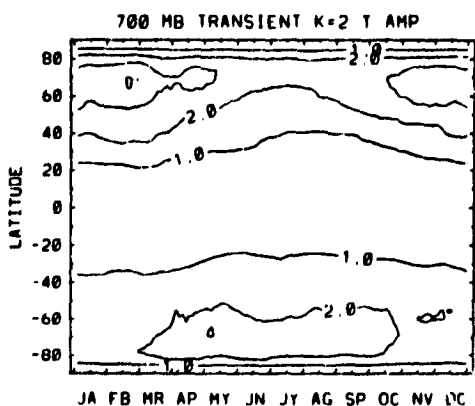
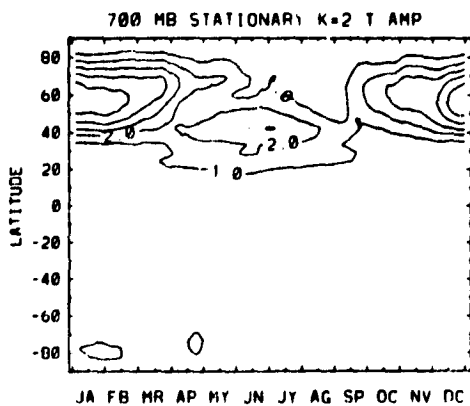
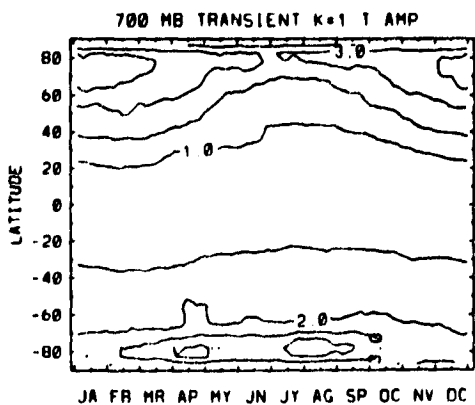
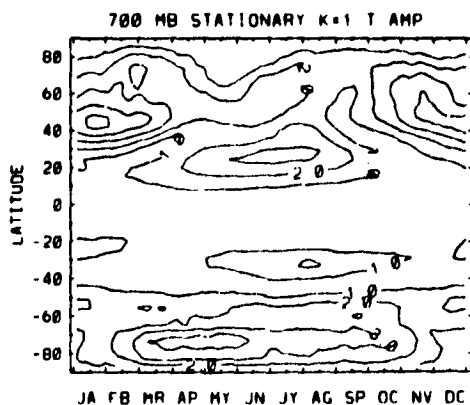
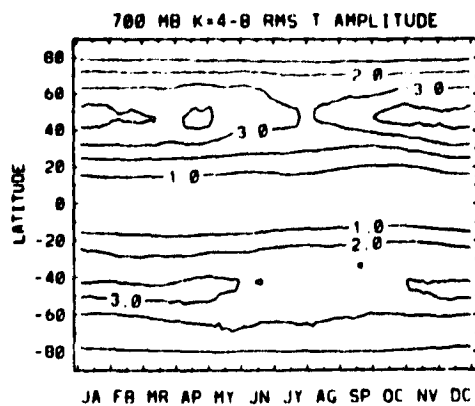
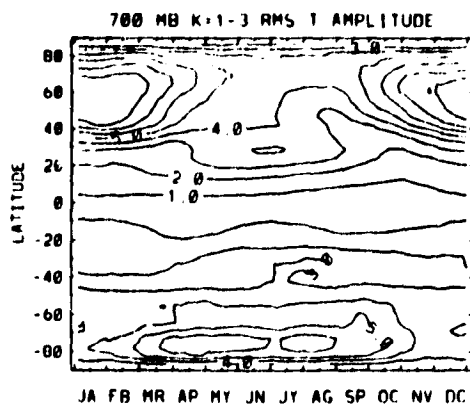


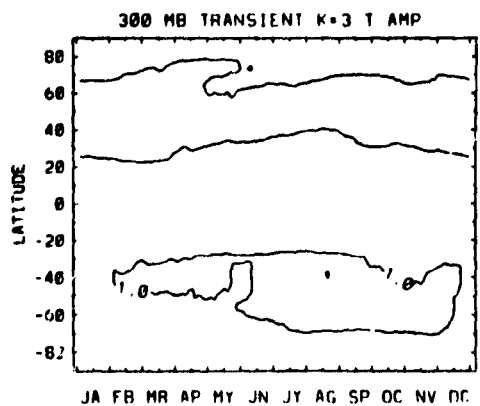
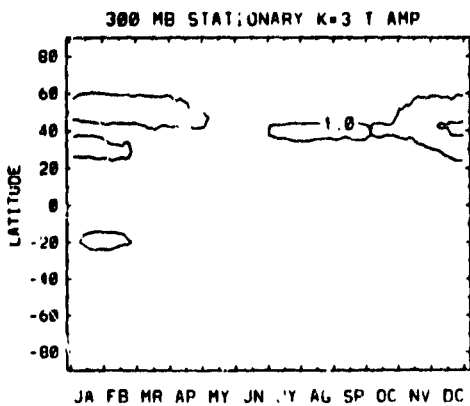
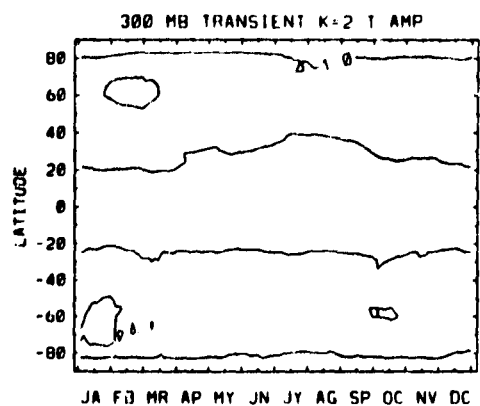
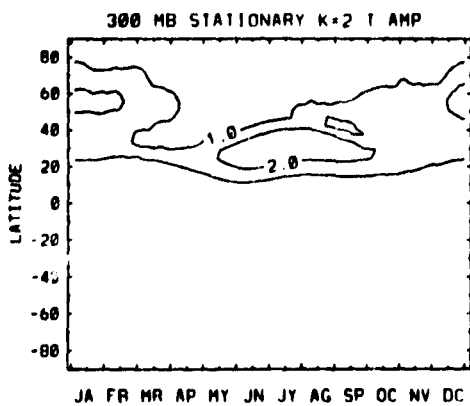
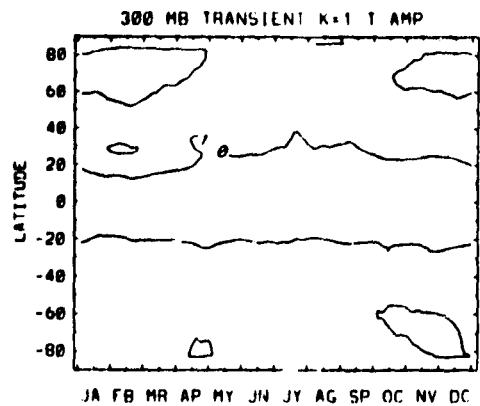
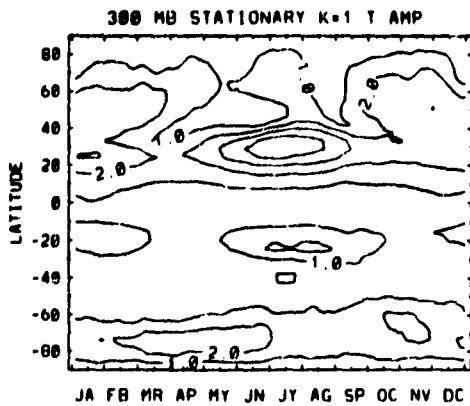
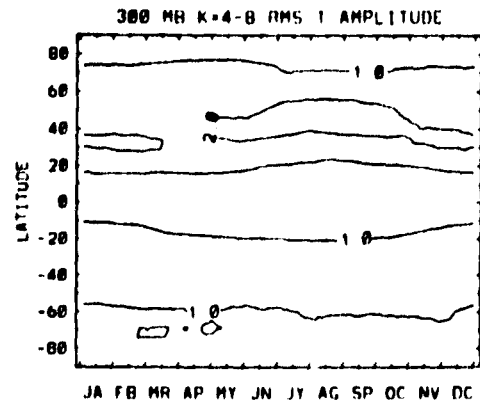
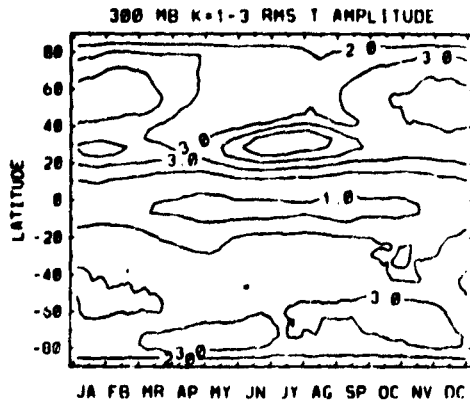


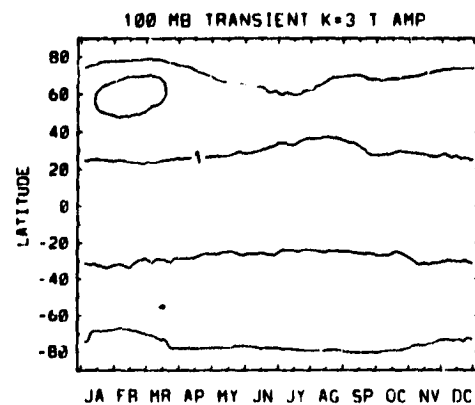
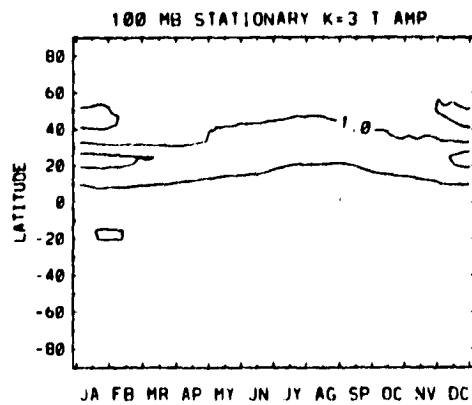
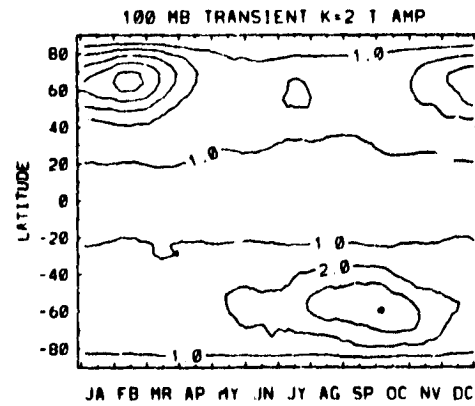
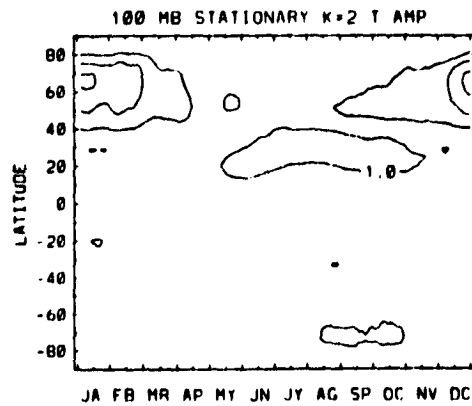
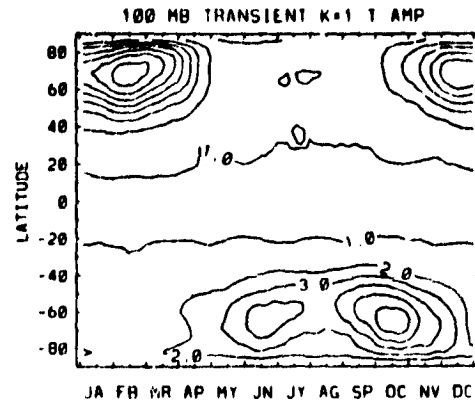
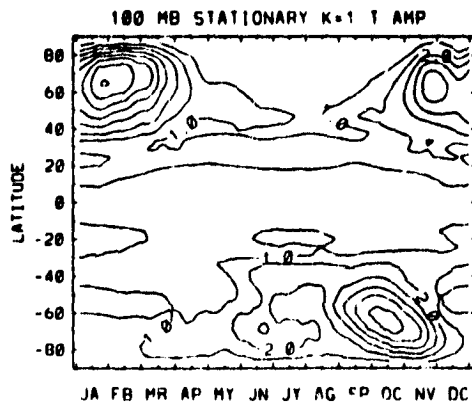
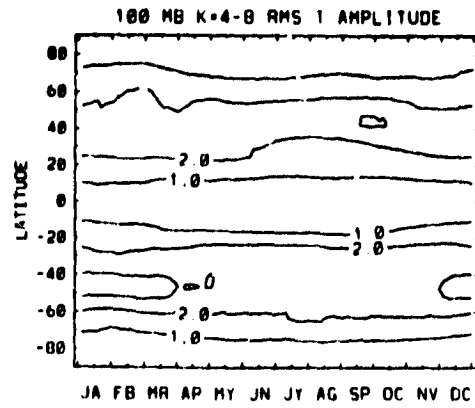
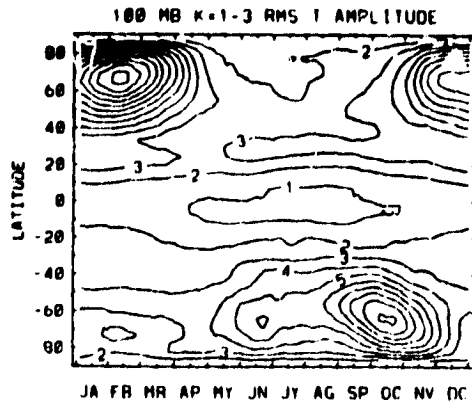


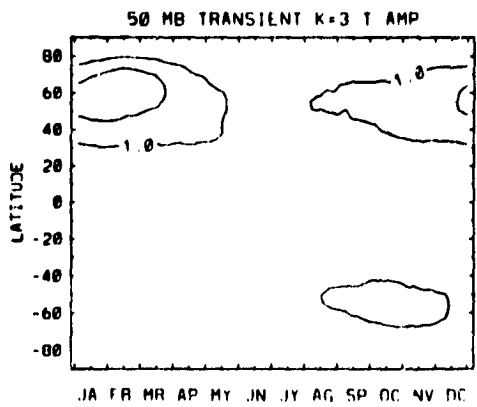
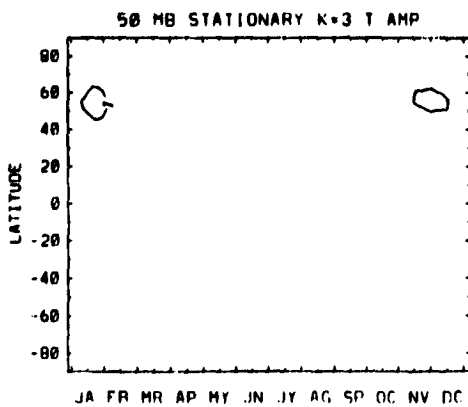
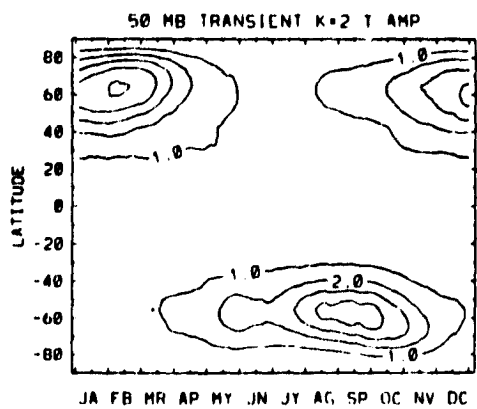
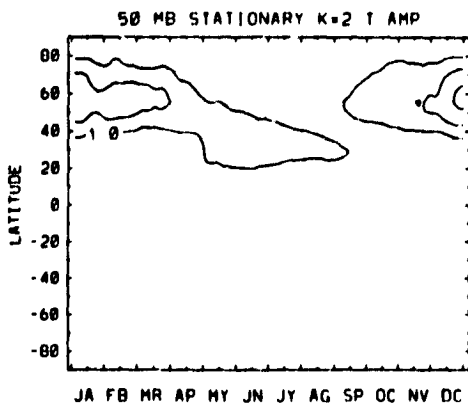
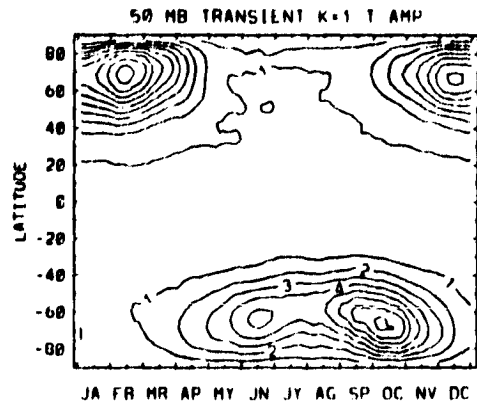
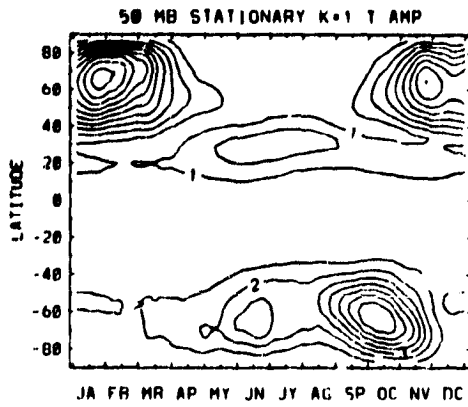
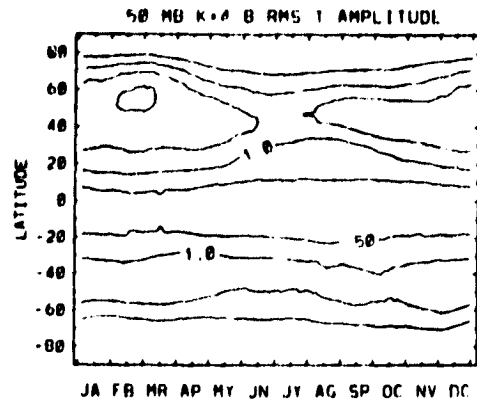
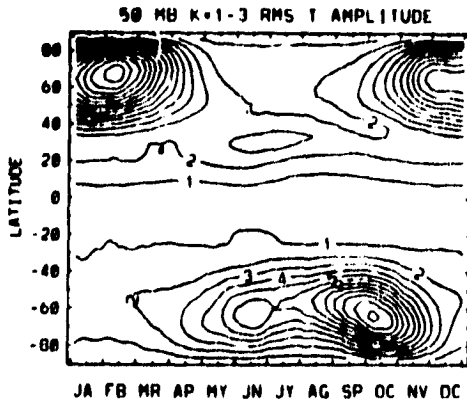


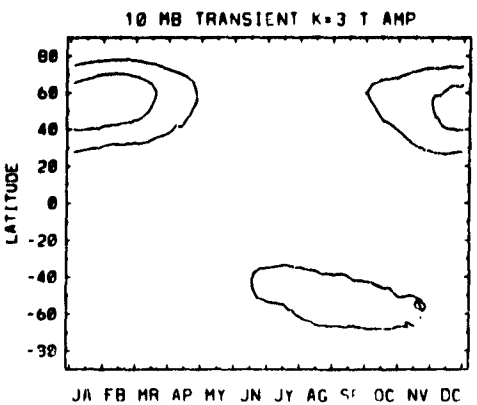
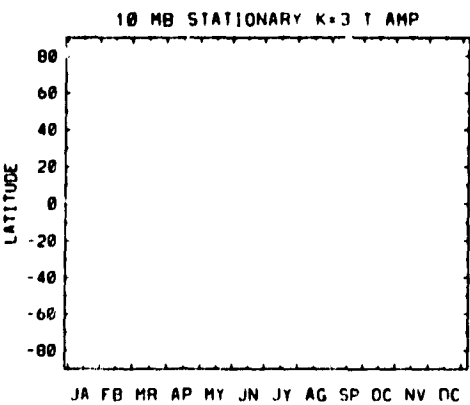
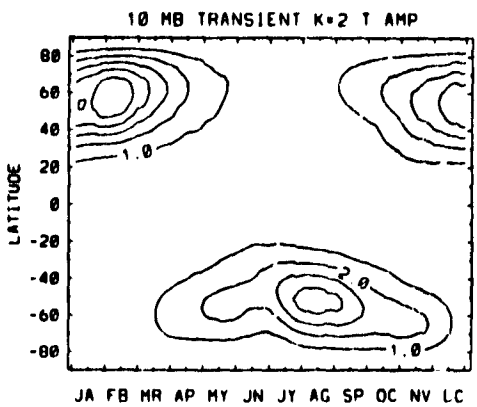
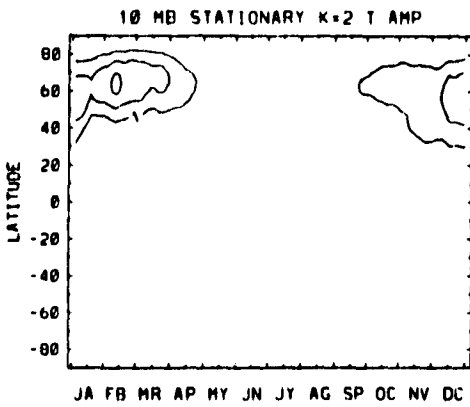
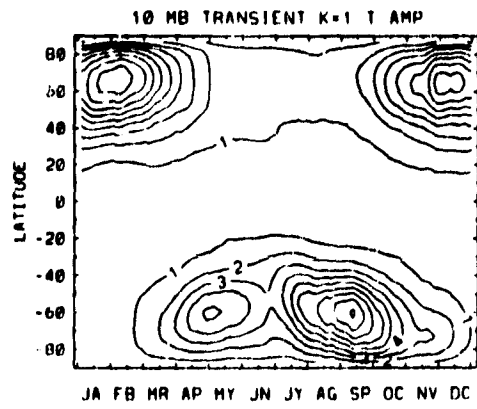
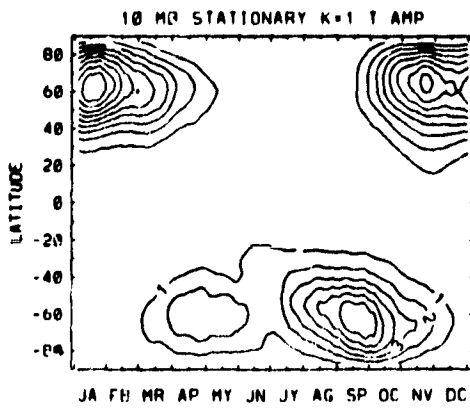
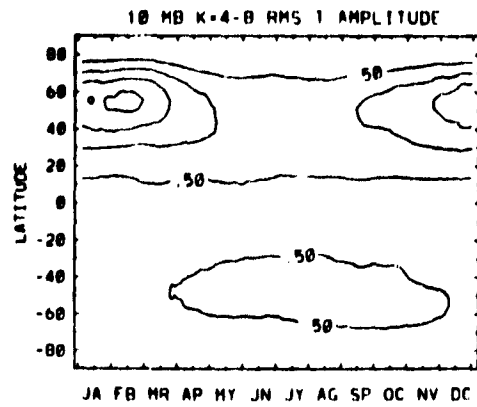
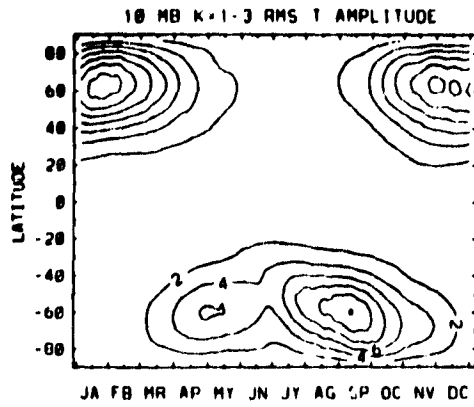


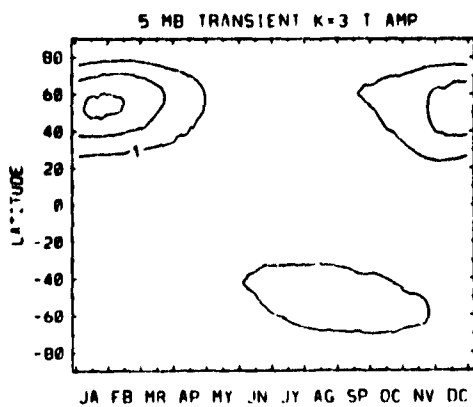
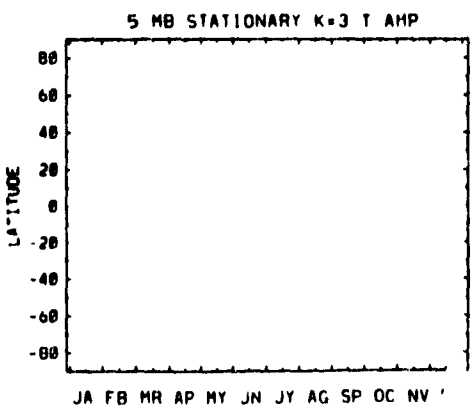
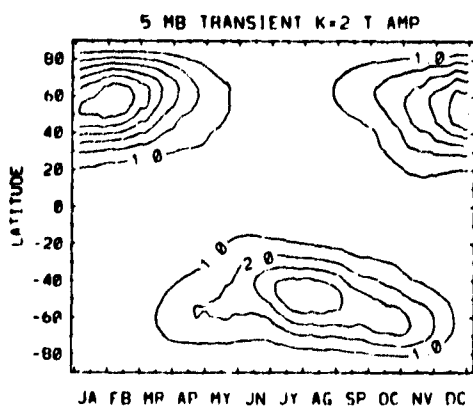
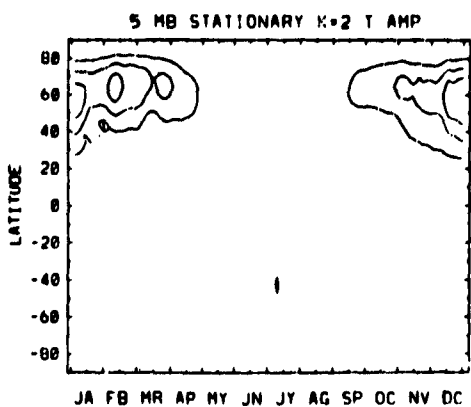
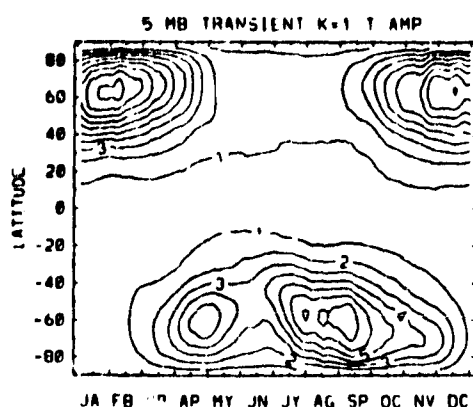
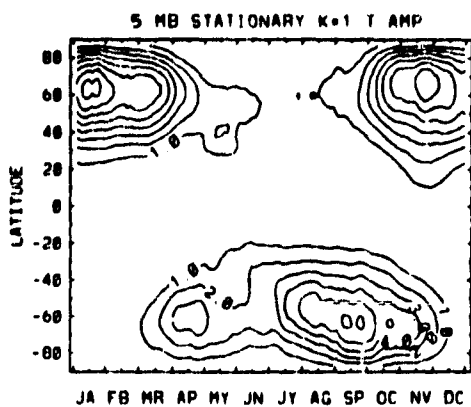
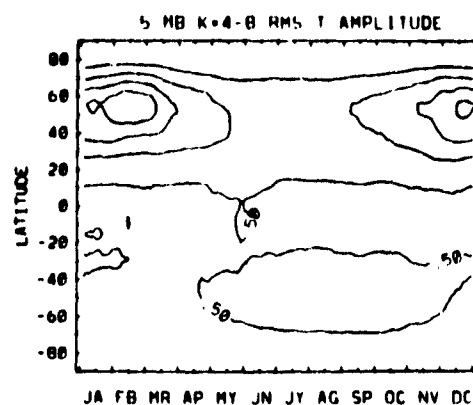
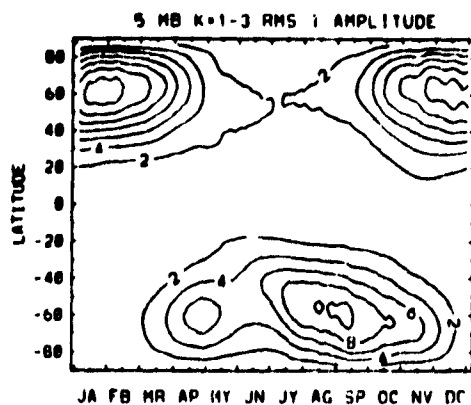


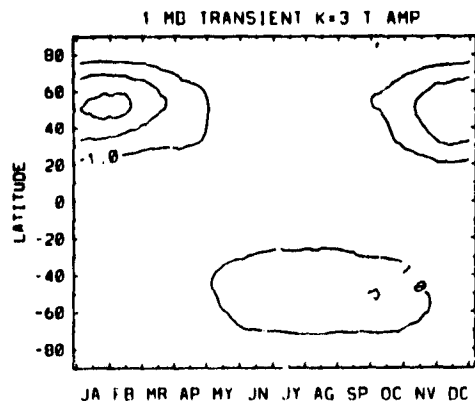
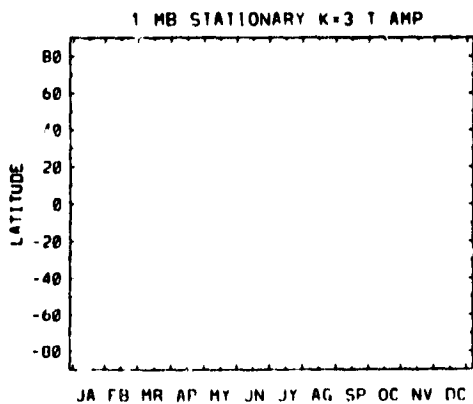
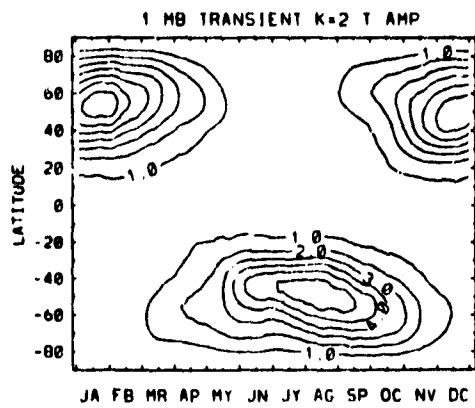
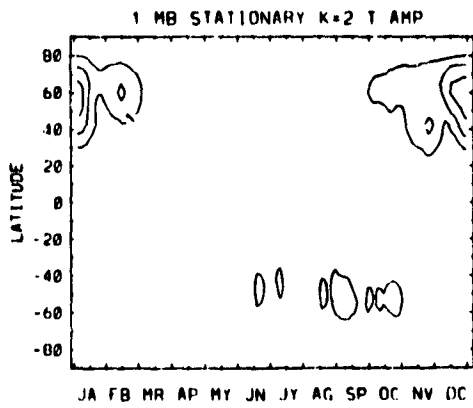
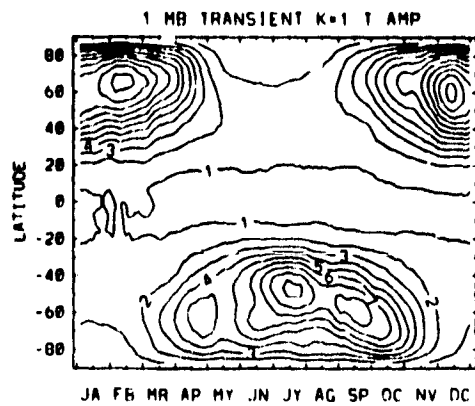
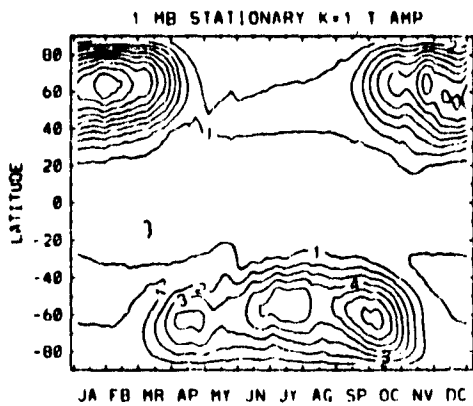
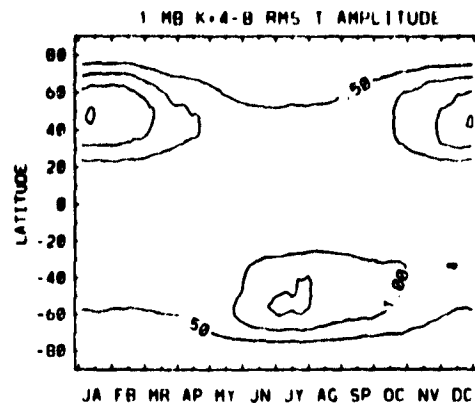
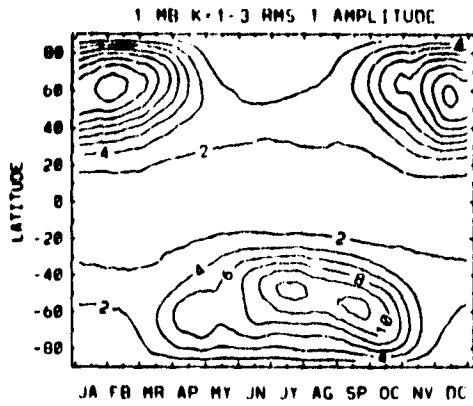


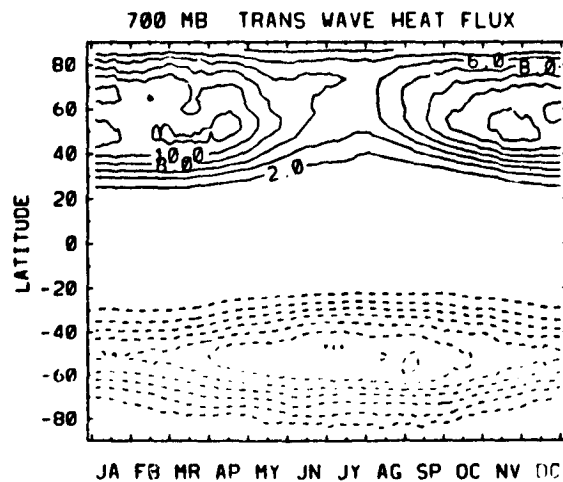
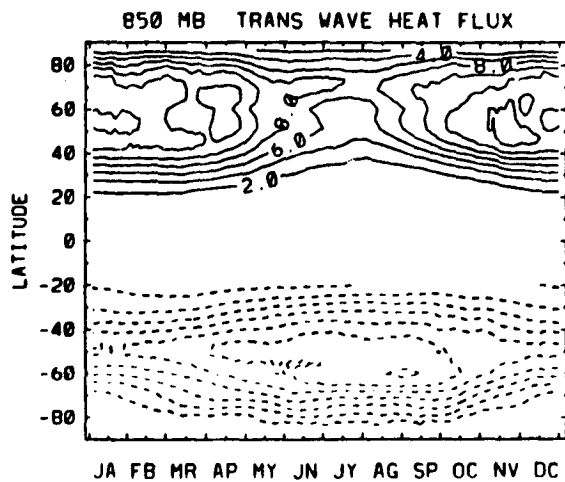
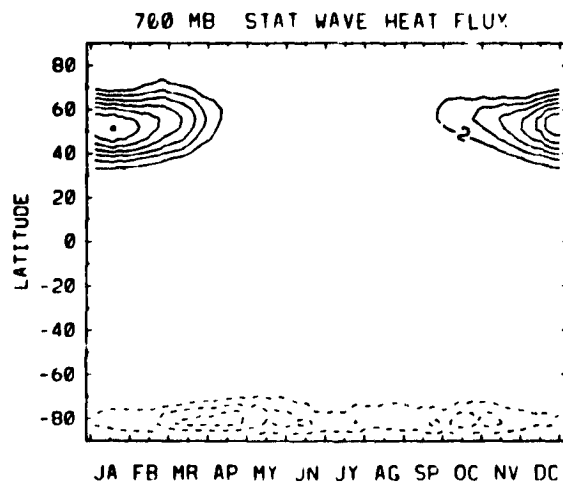
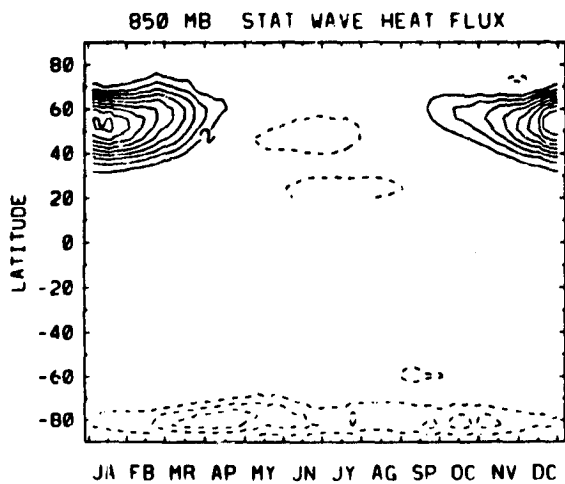
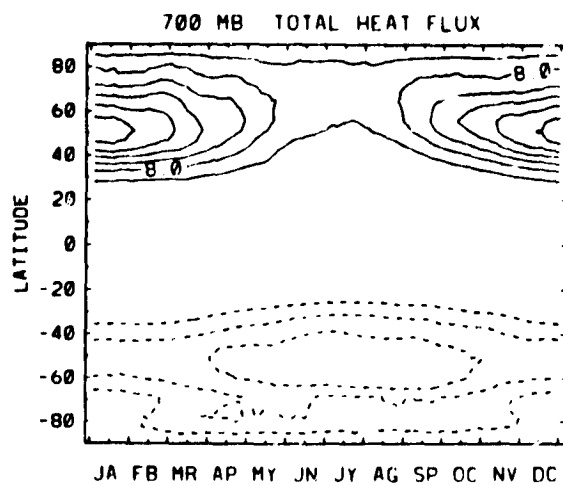
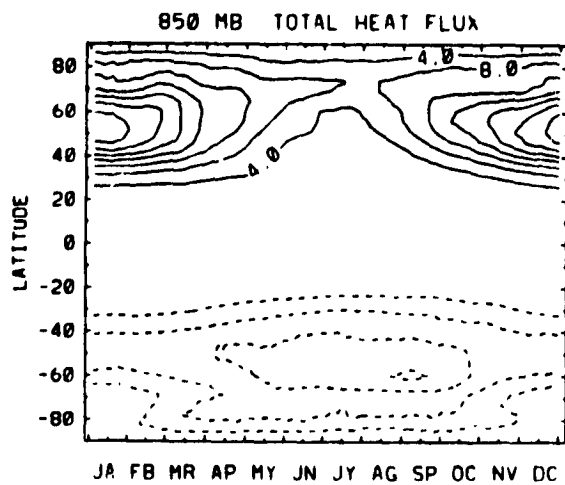


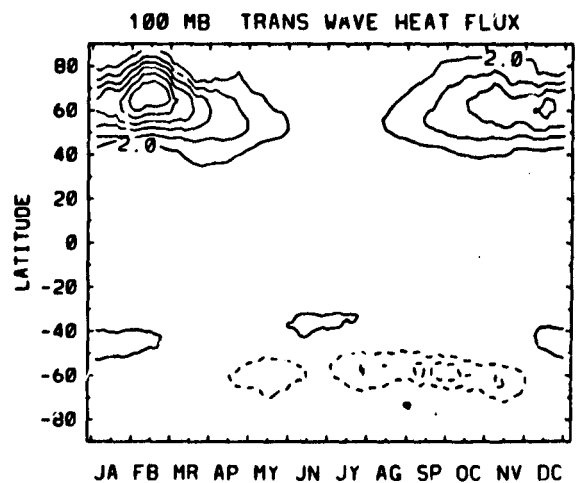
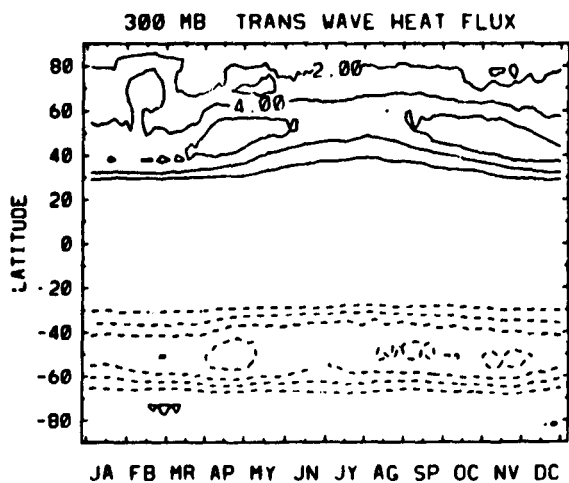
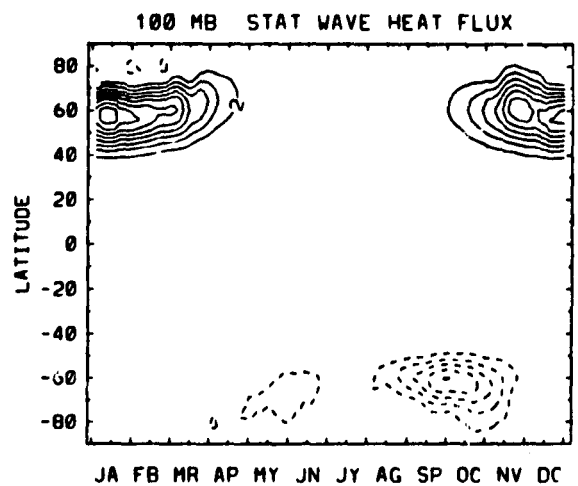
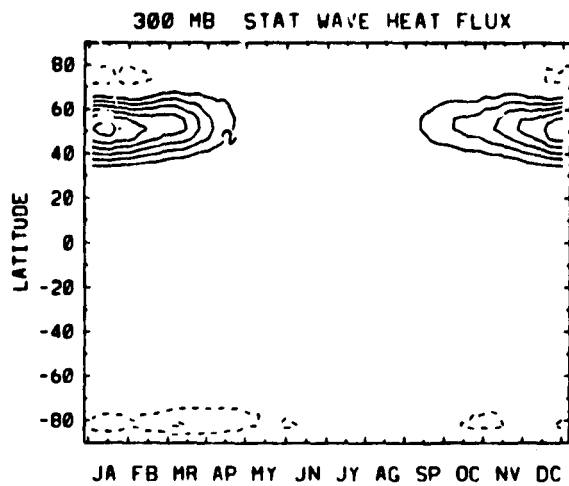
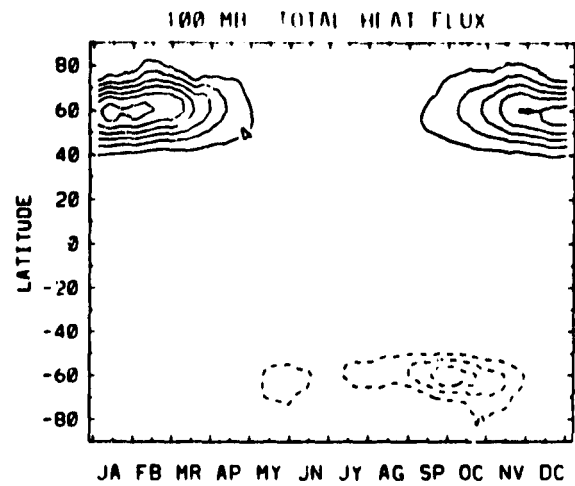
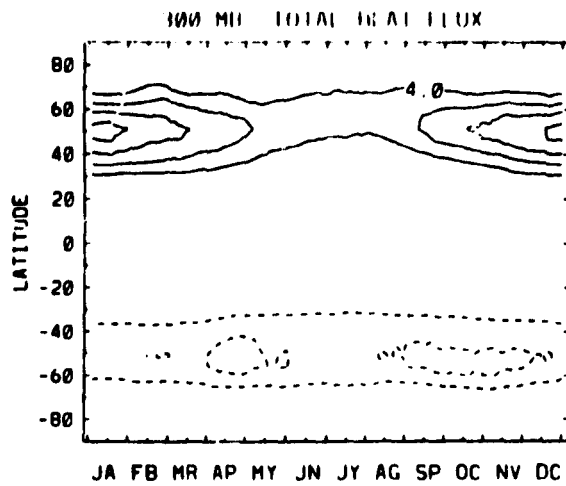


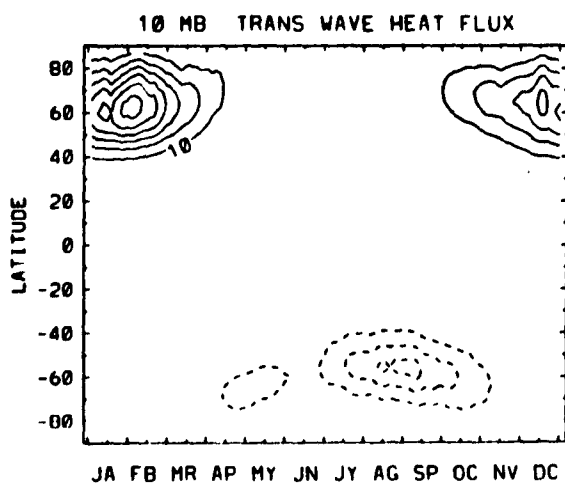
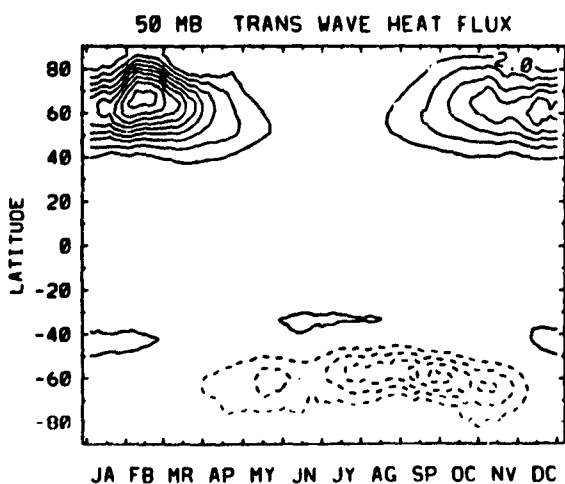
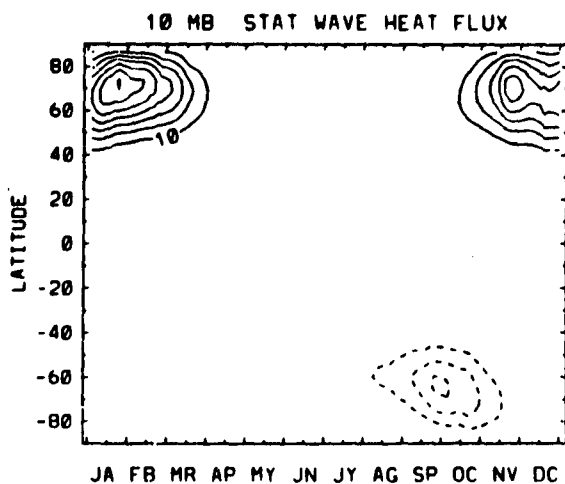
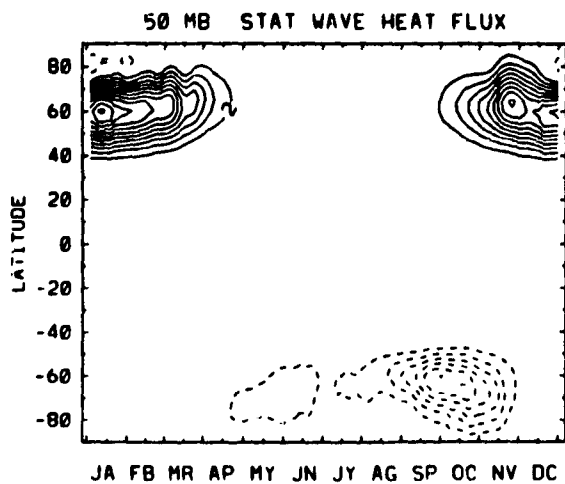
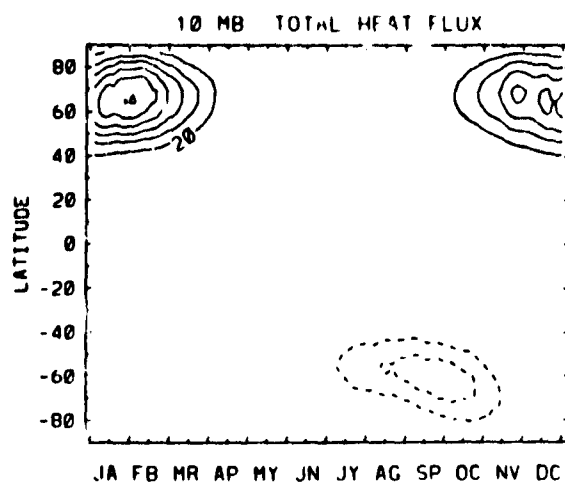
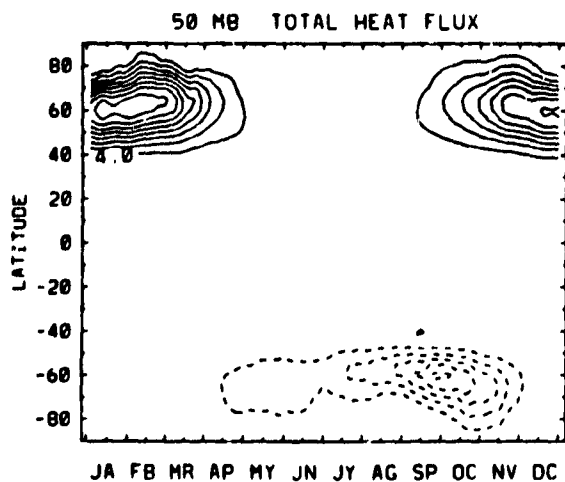


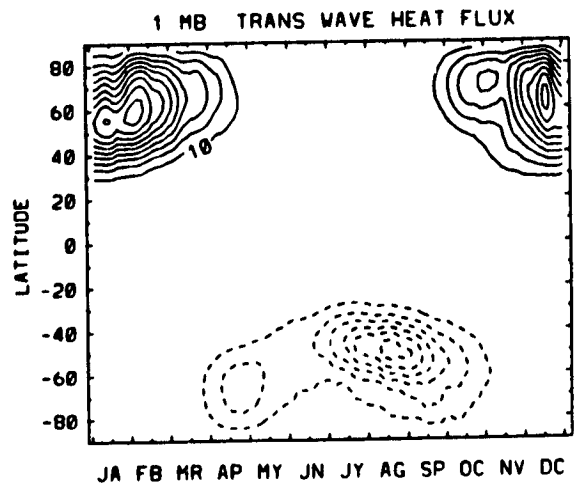
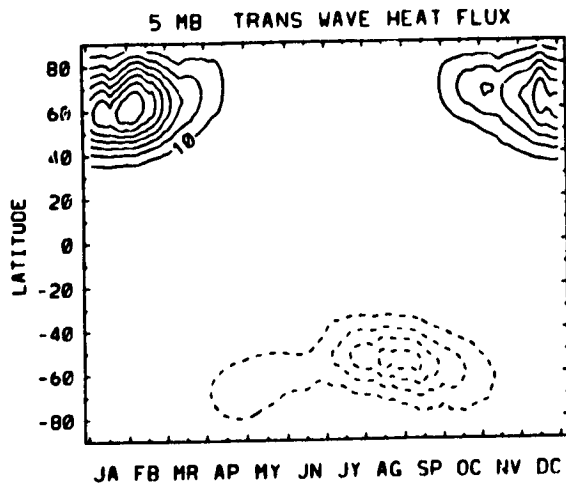
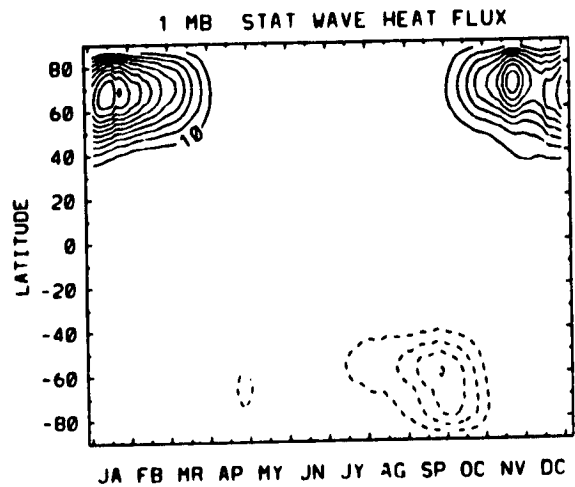
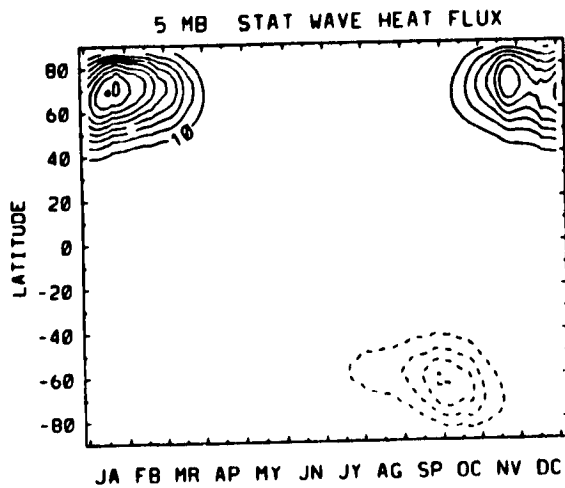
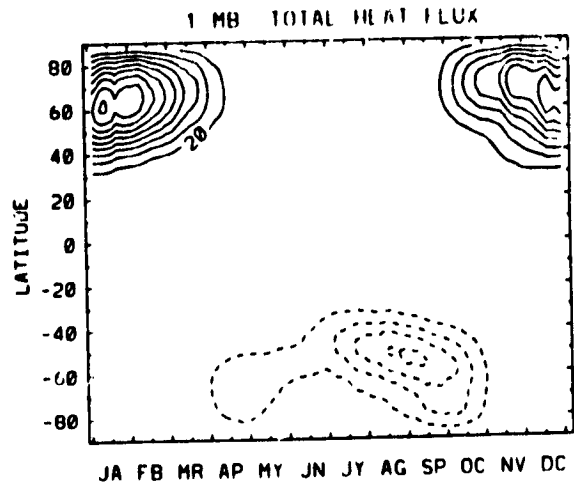
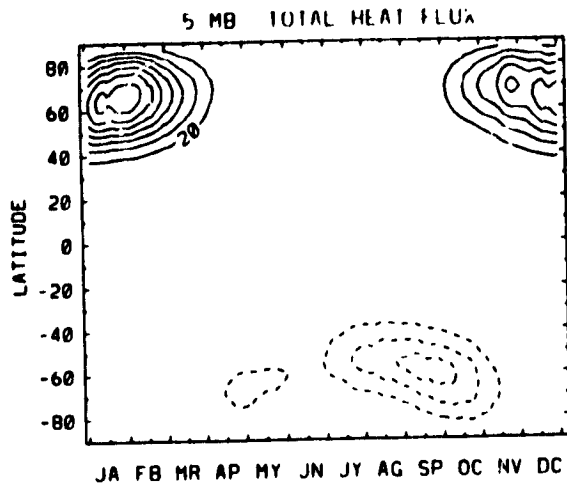


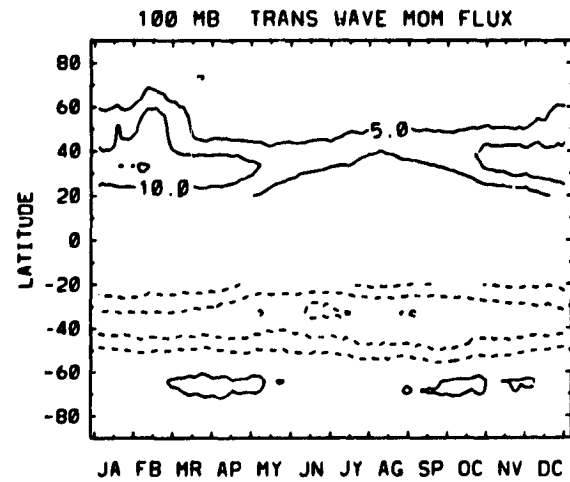
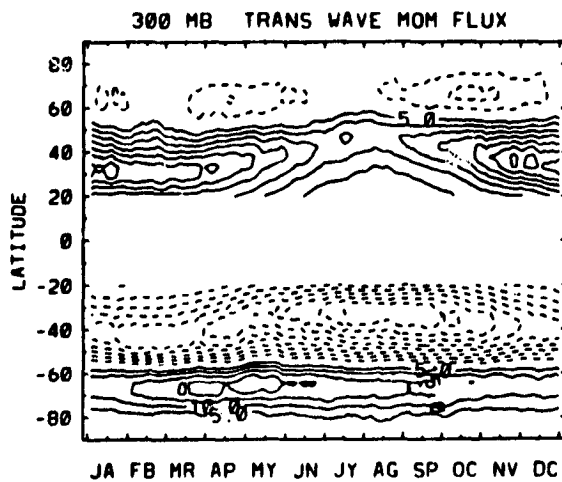
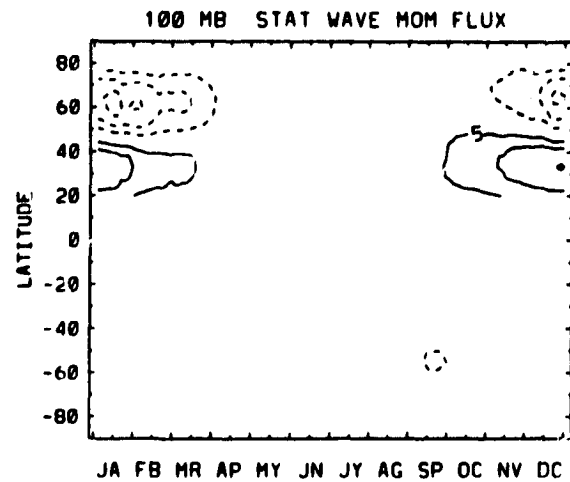
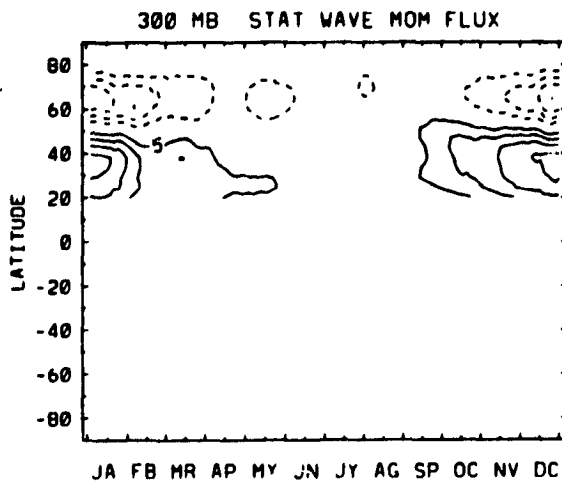
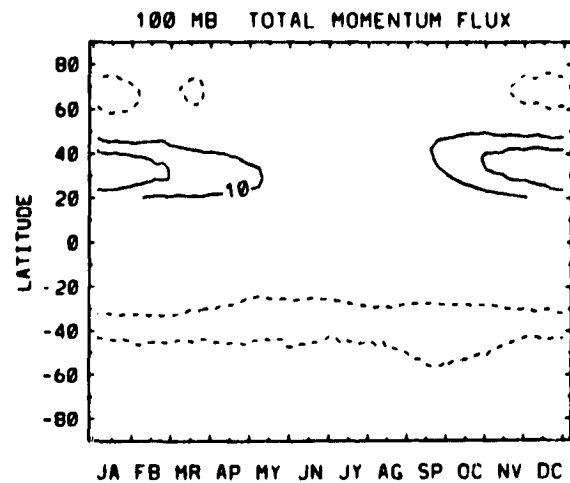
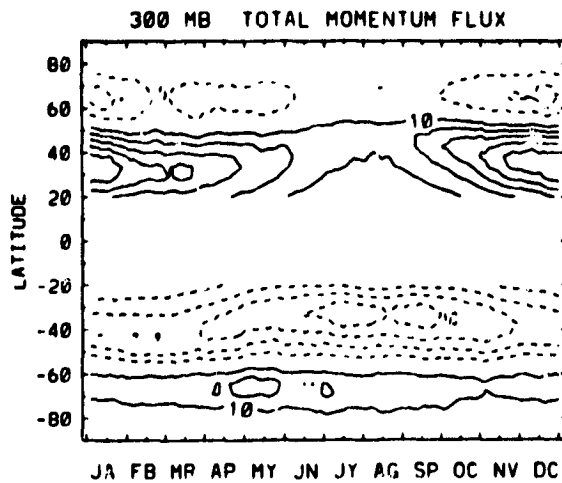


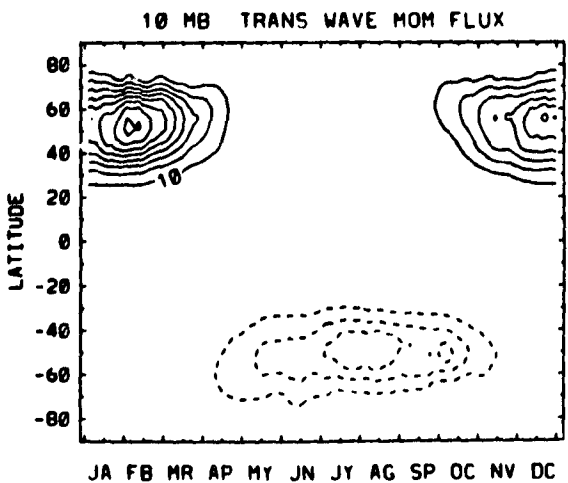
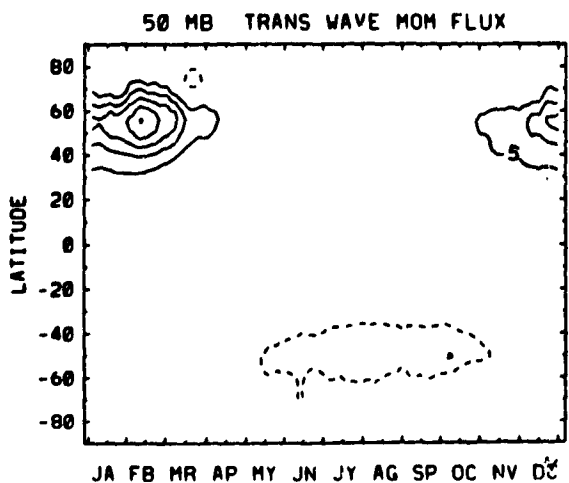
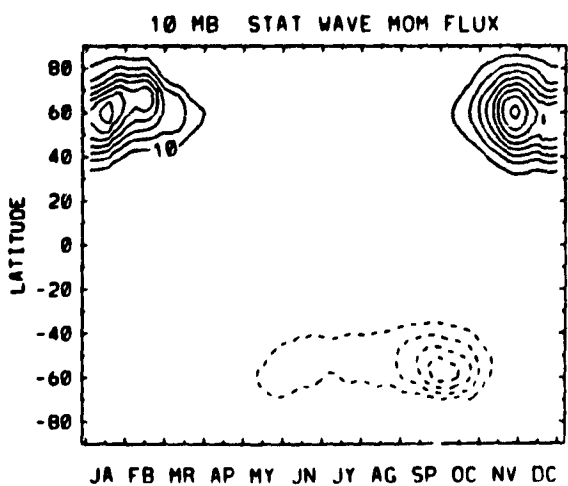
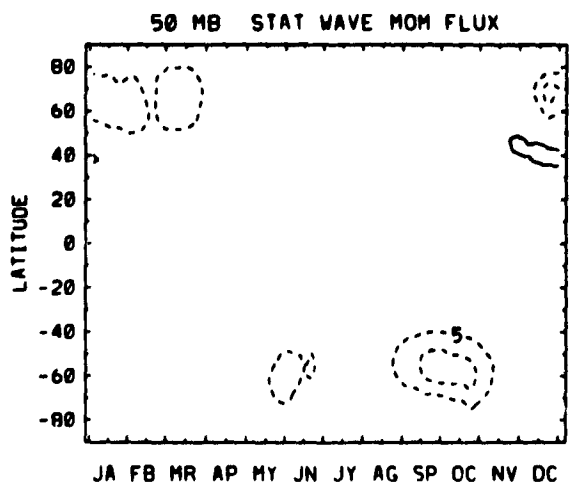
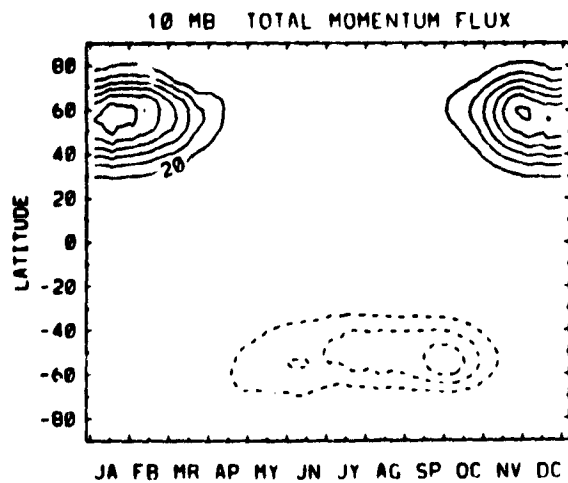
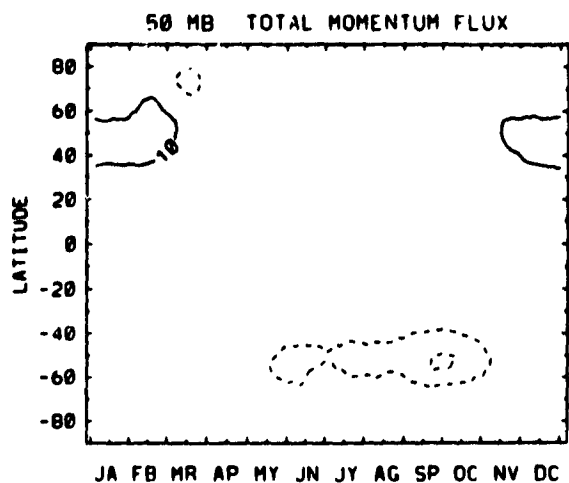


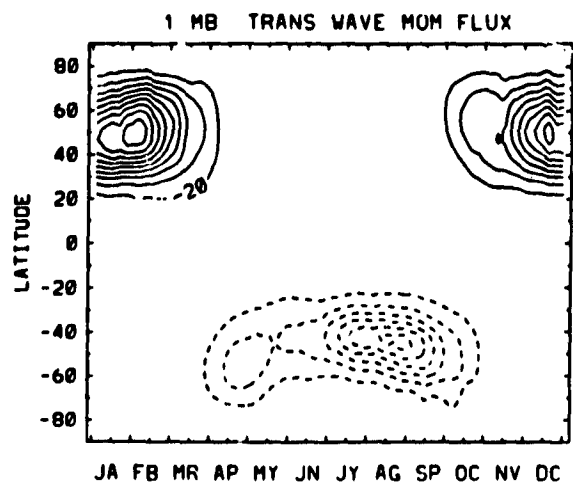
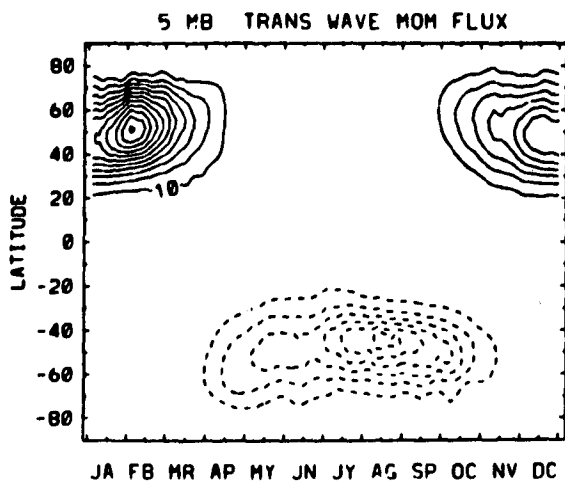
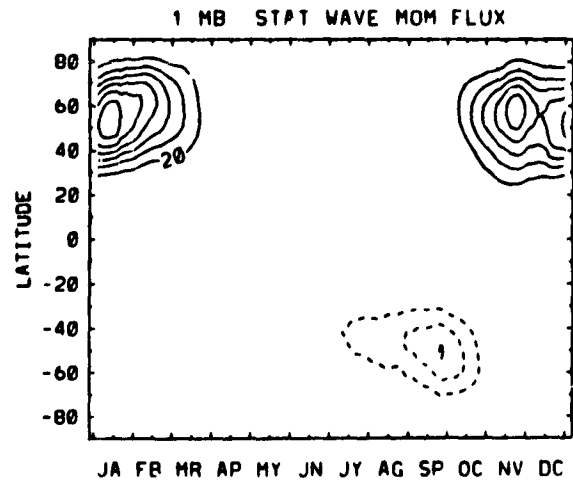
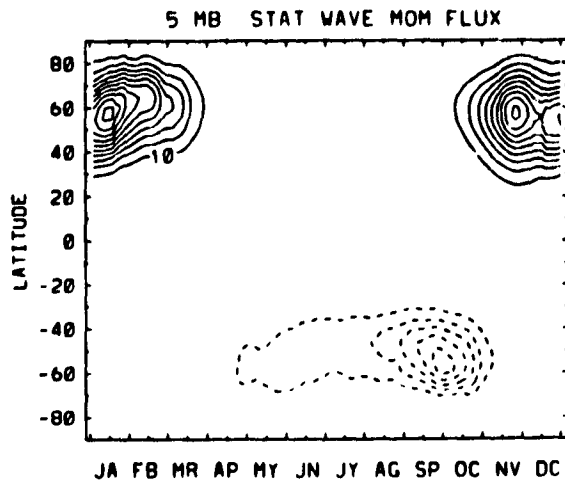
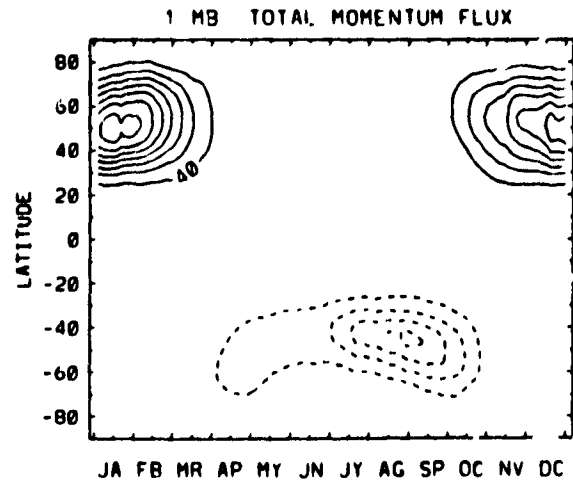
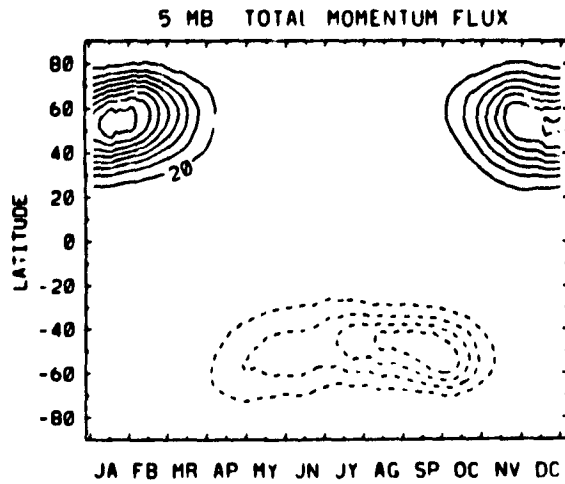


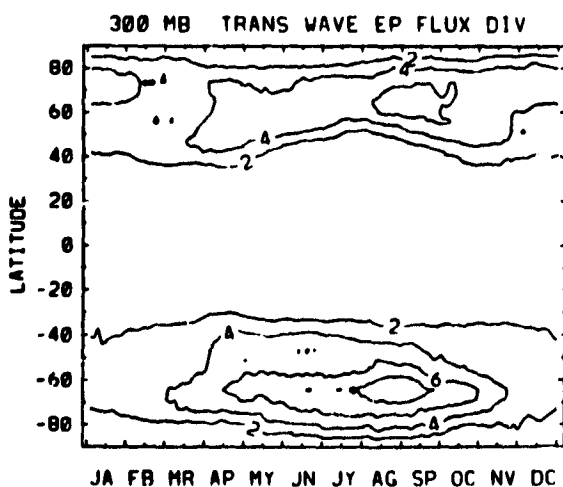
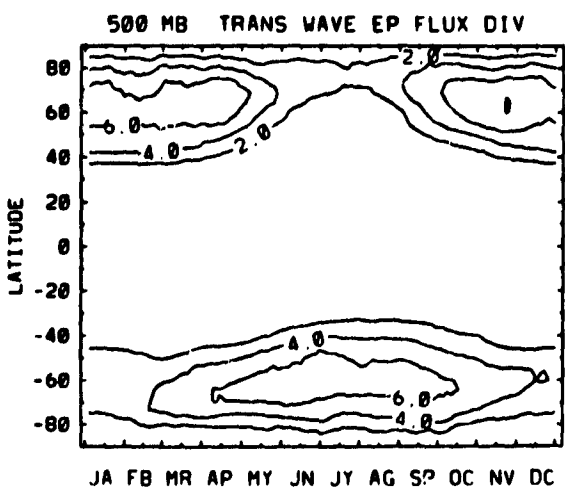
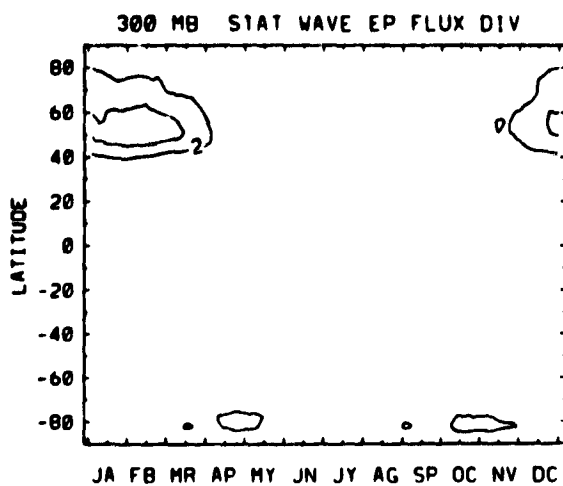
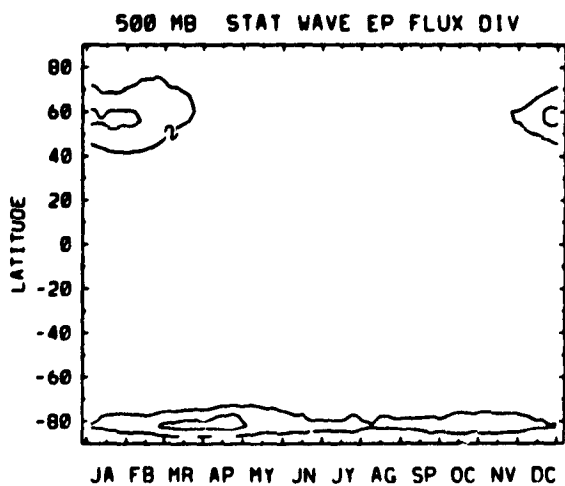
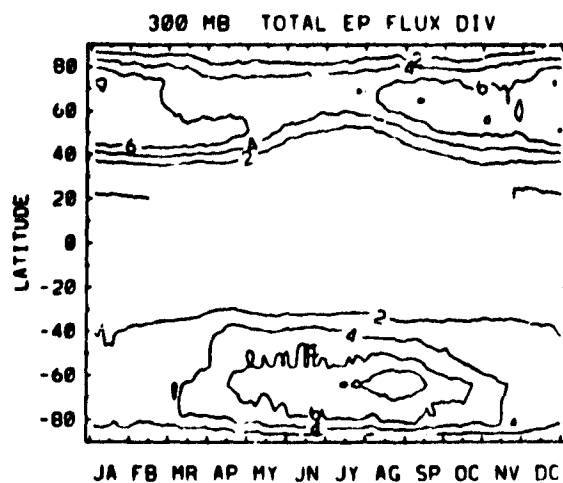
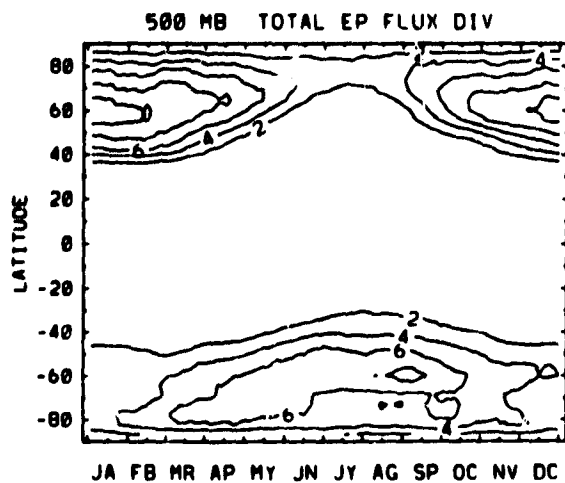


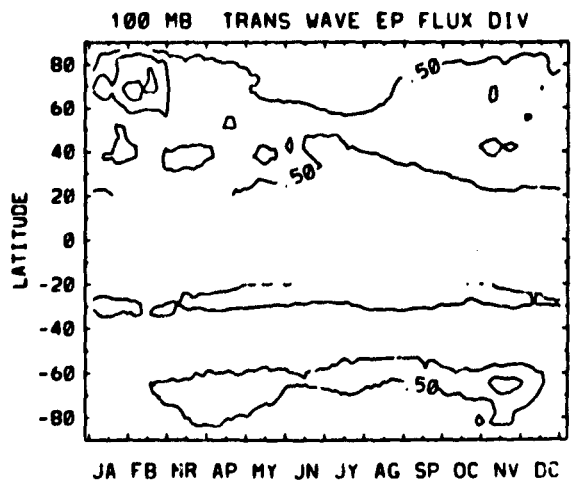
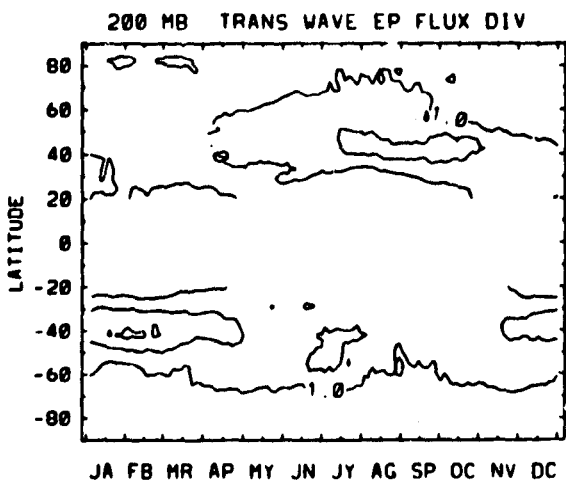
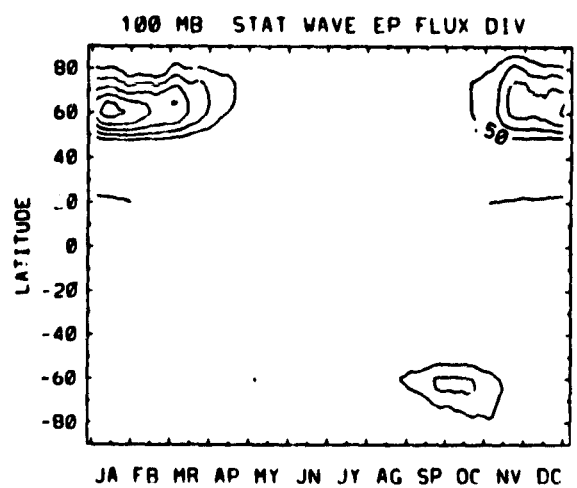
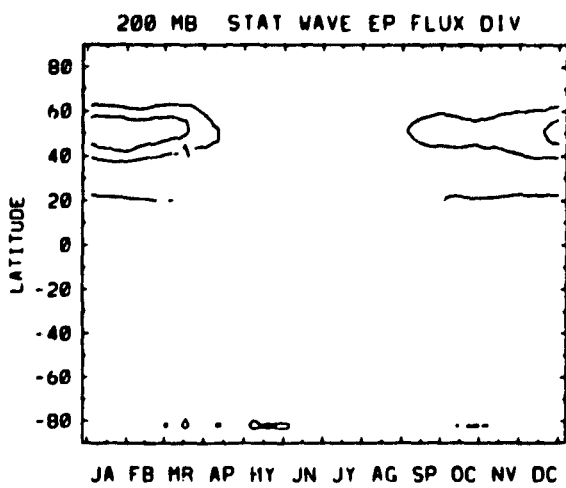
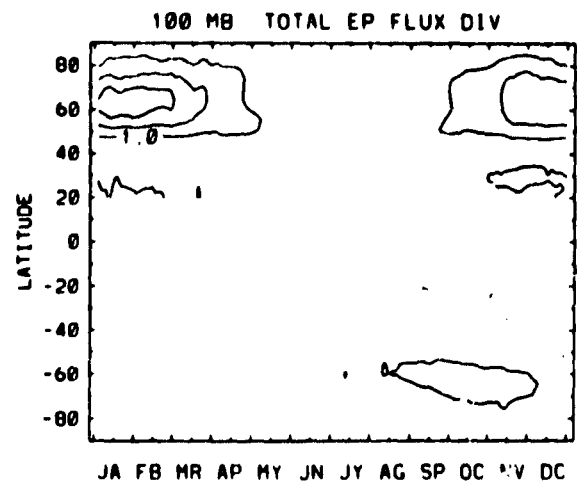
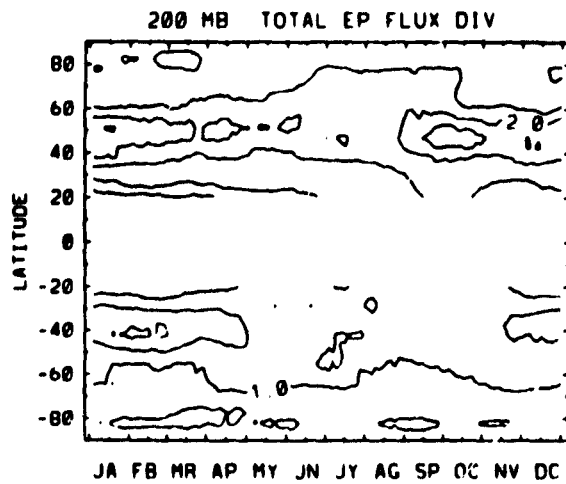


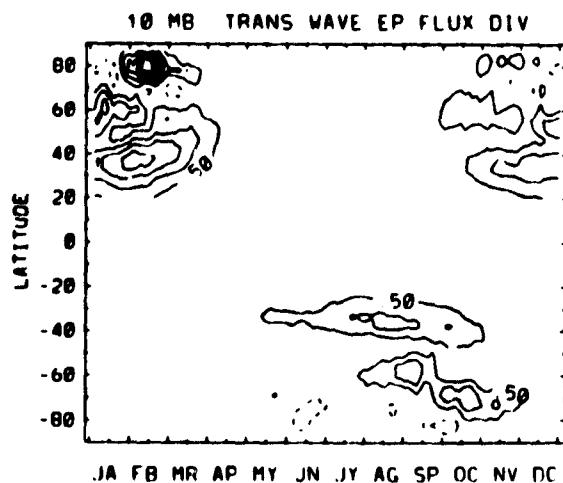
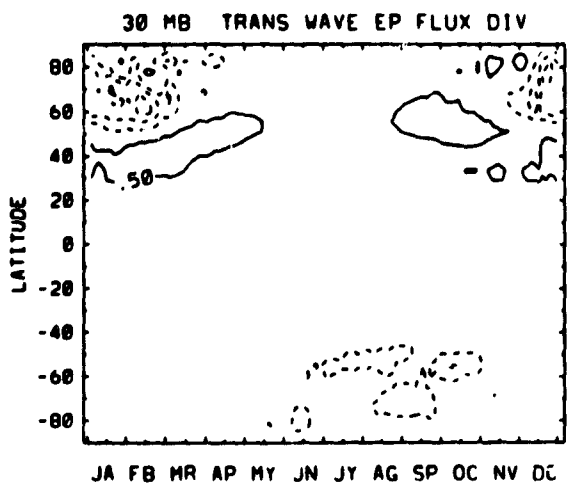
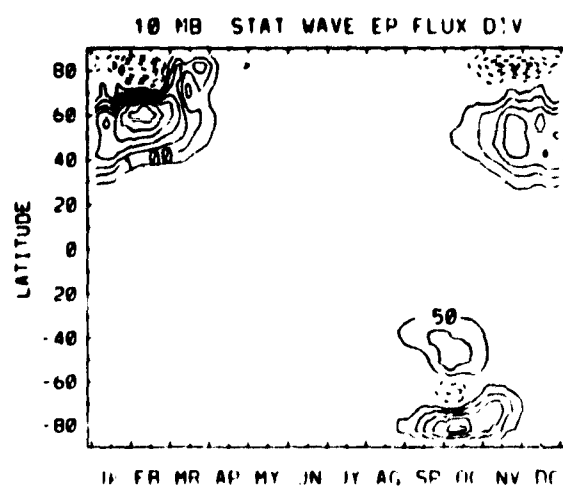
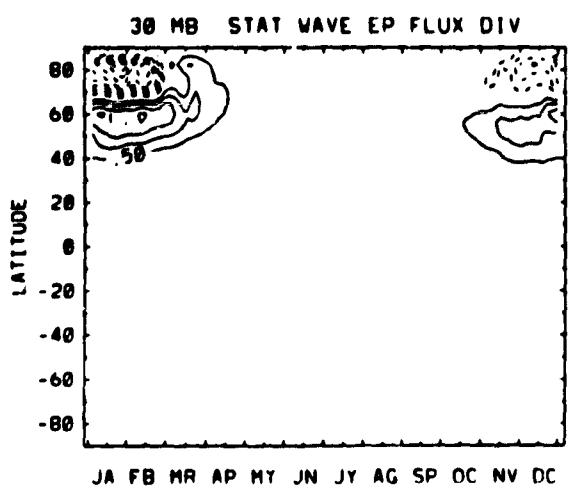
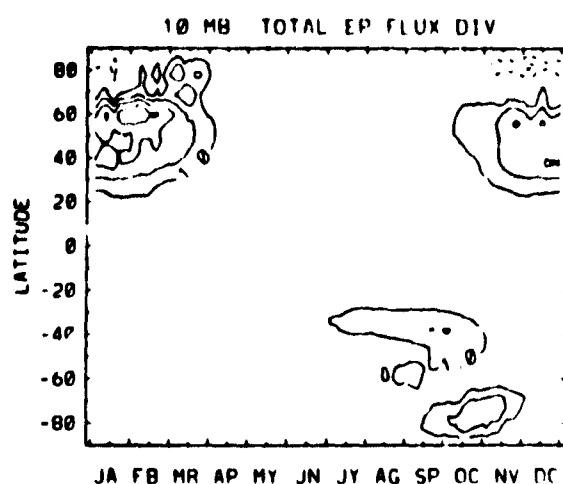
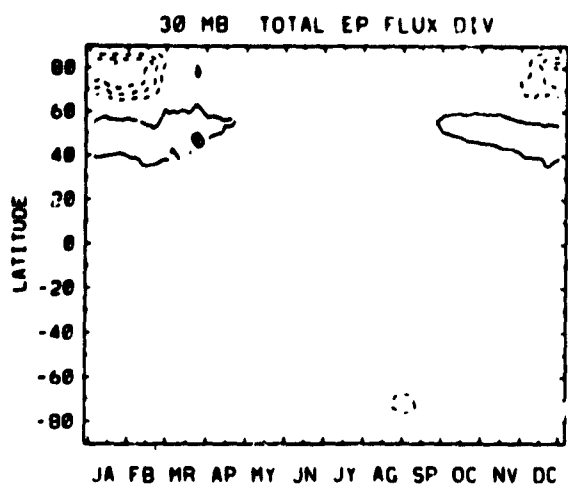


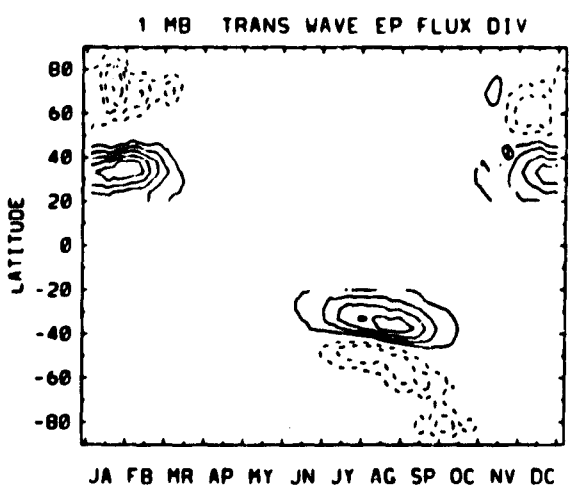
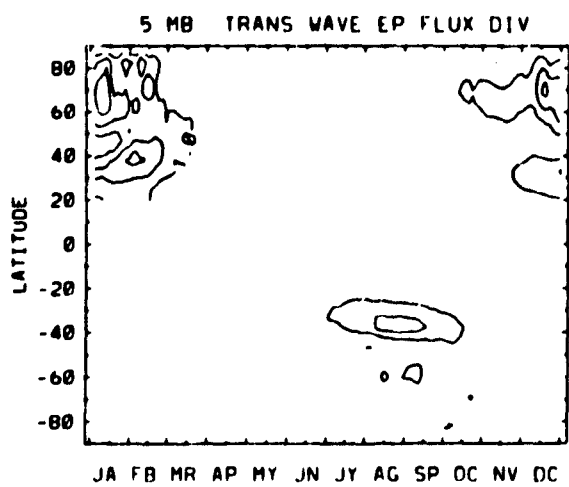
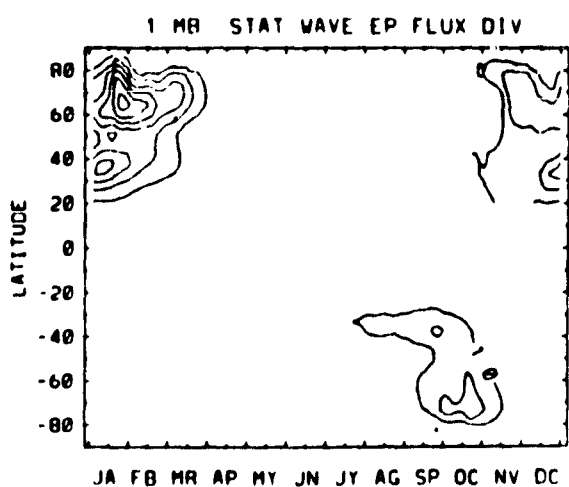
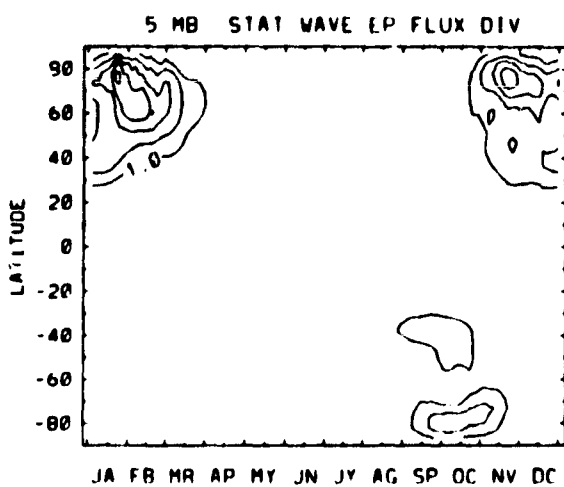
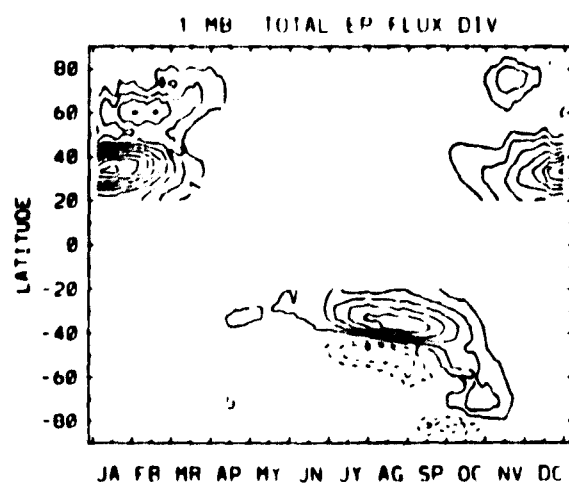
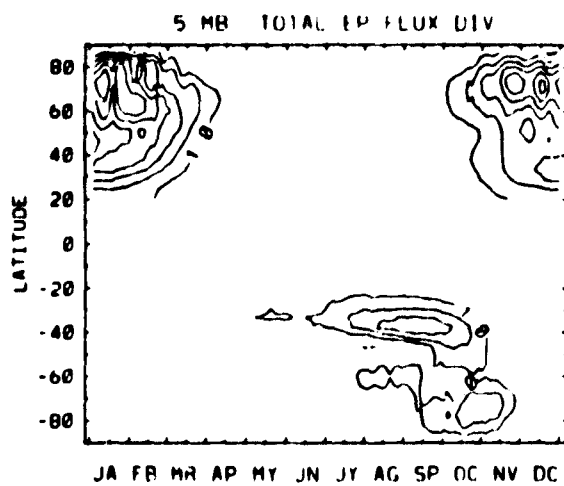








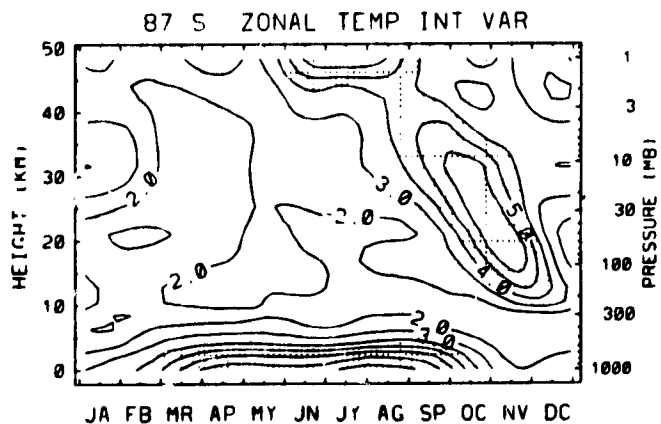
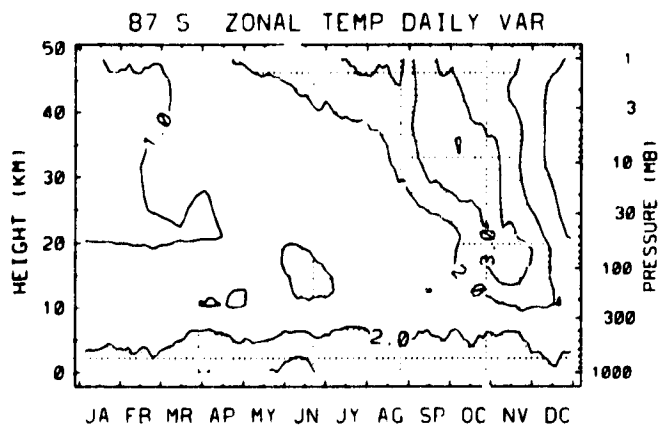
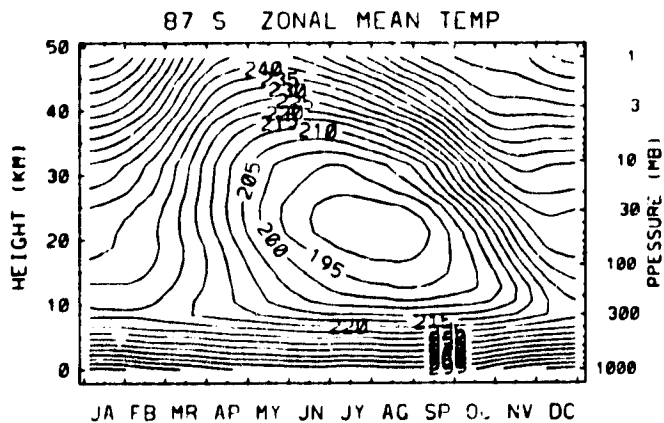




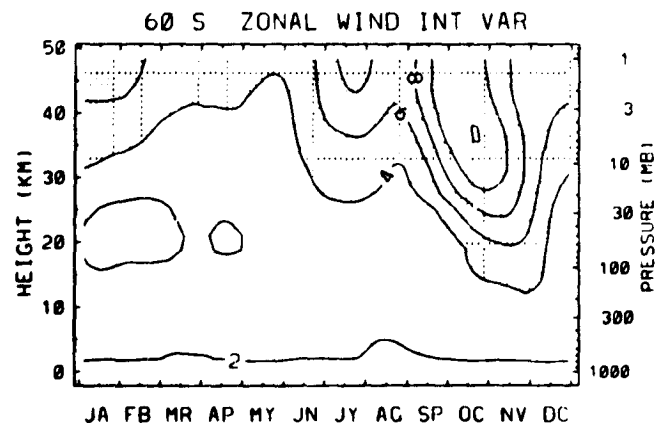
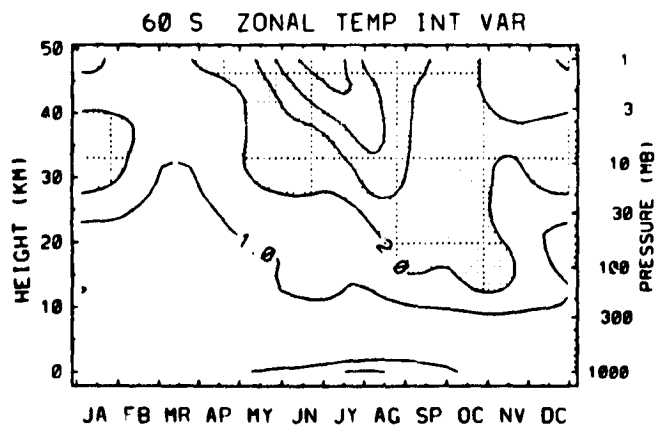
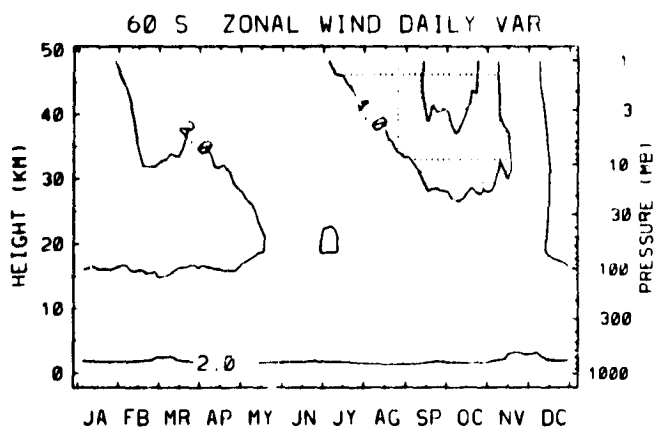
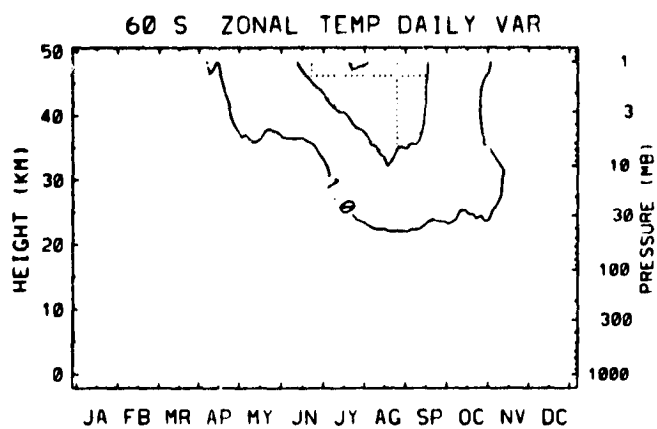
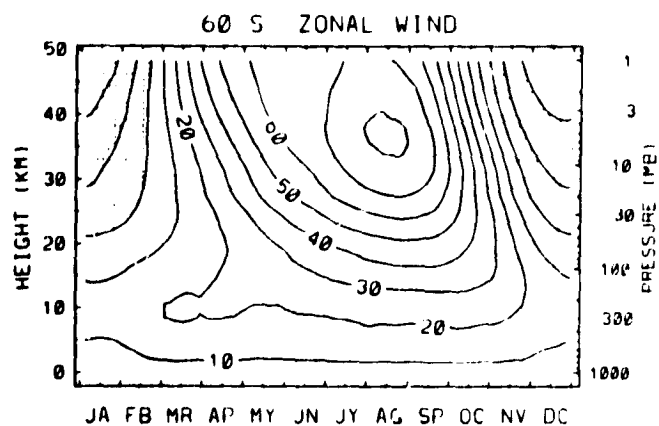
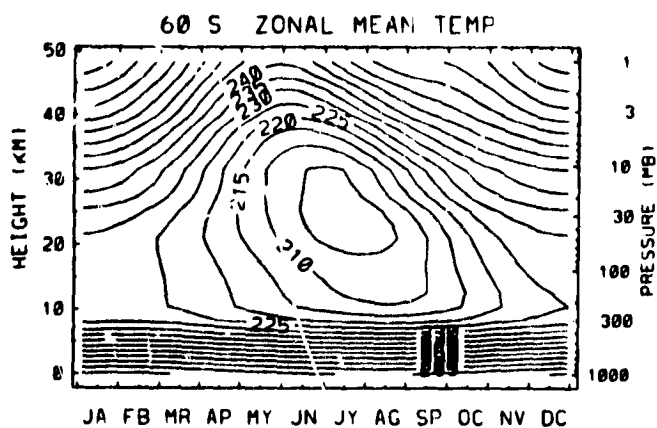
ENSEMBLE AVERAGE HEIGHT-TIME DIAGRAM

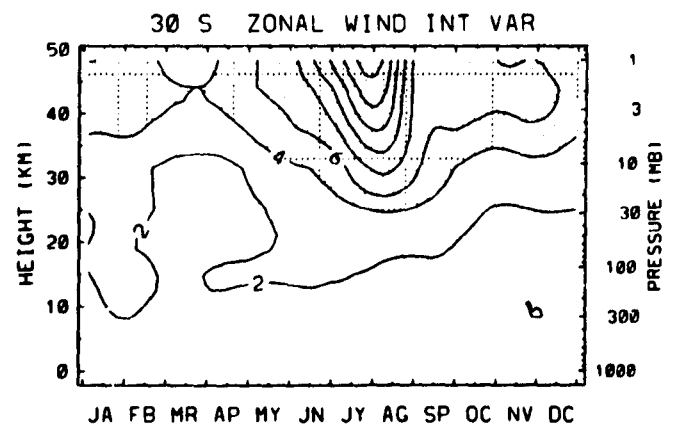
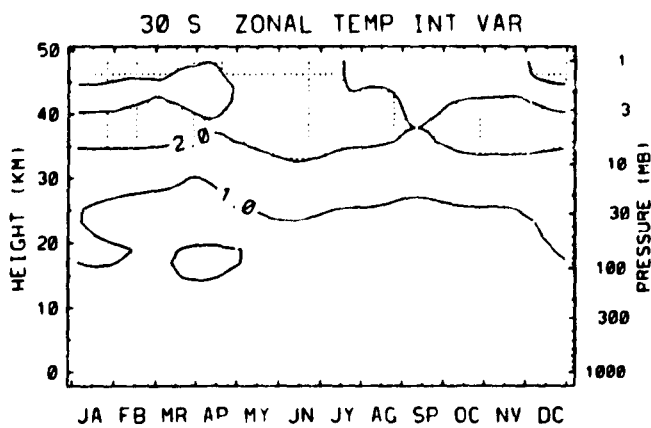
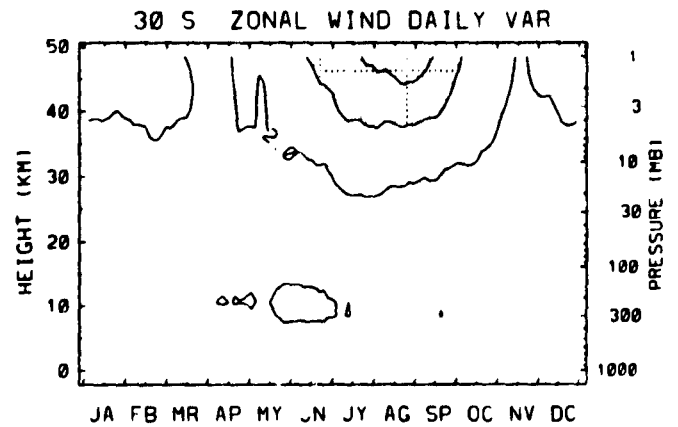
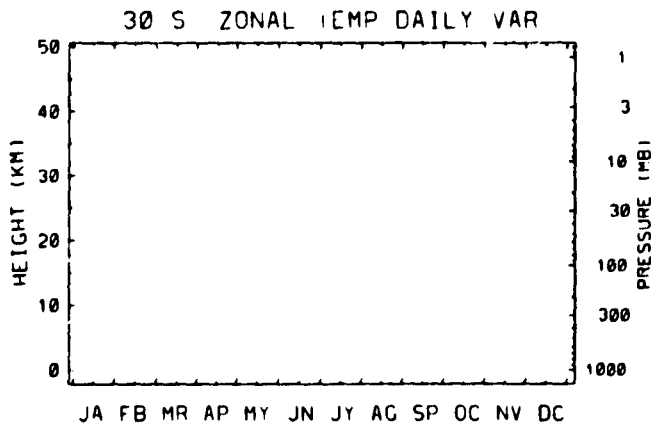
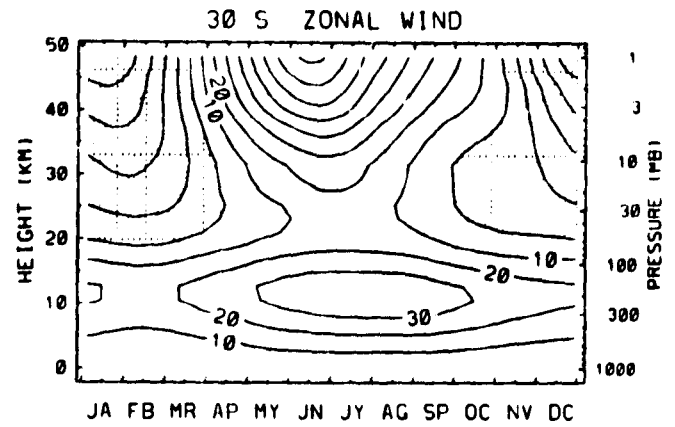
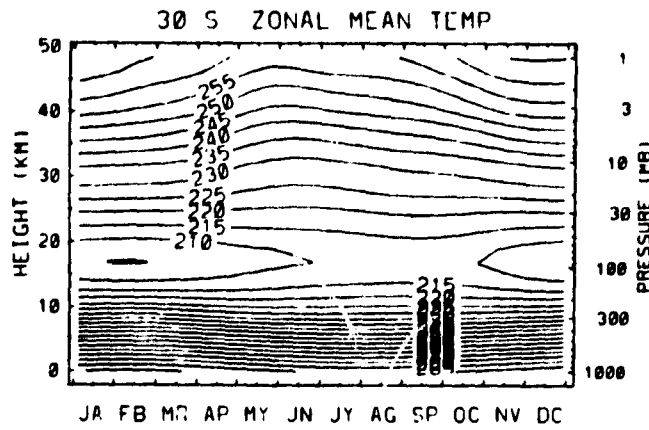
<u>Quantity</u>	<u>Units</u>
Zonal mean temperatures	(K)
Zonal mean winds	(m/s)
Zonal mean temperature daily variability (Eq. 20)	(K)
Zonal mean wind daily variability (Eq. 20)	(m/s)
Zonal mean temperature interannual variability (Eq. 21)	(K)
Zonal mean wind interannual variability (Eq. 21)	(m/s)
RMS stationary and transient wave geopotential height wave amplitudes (Eqns. 22-24)	(m)
RMS stationary and transient temperature wave amplitudes (Eqns. 22-24)	(K)

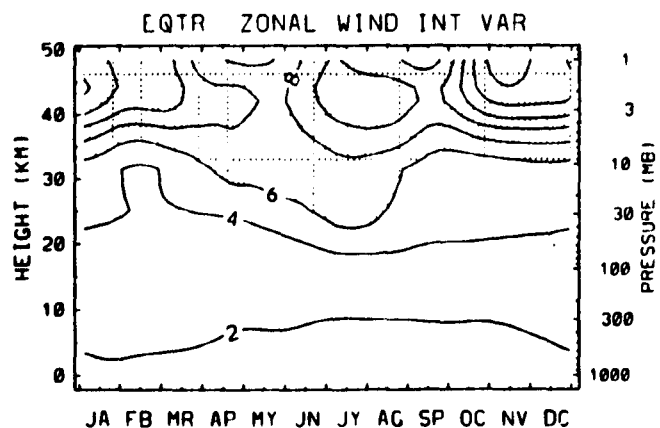
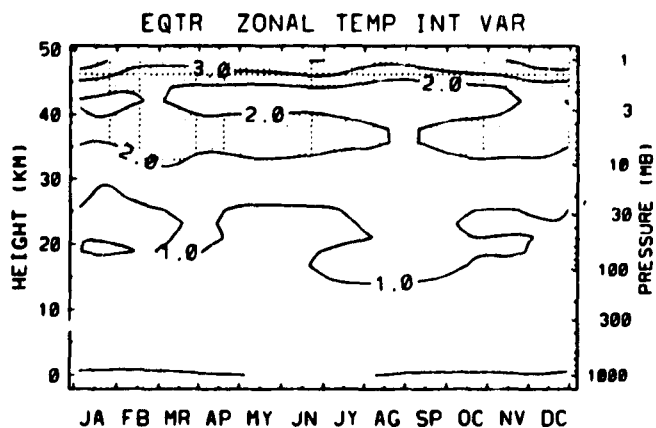
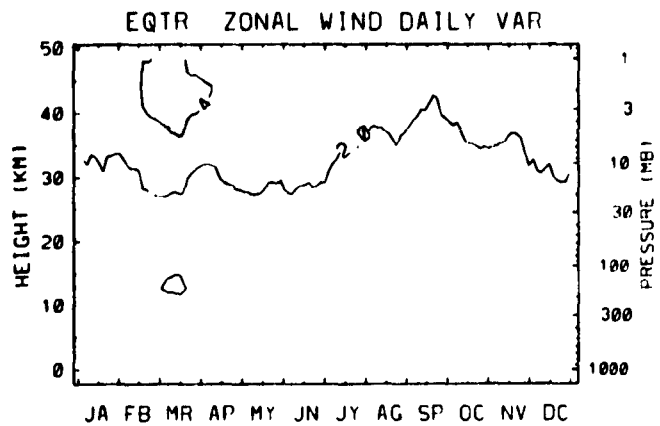
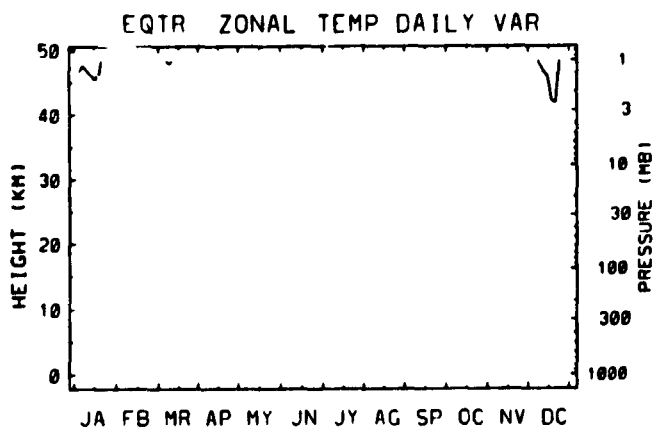
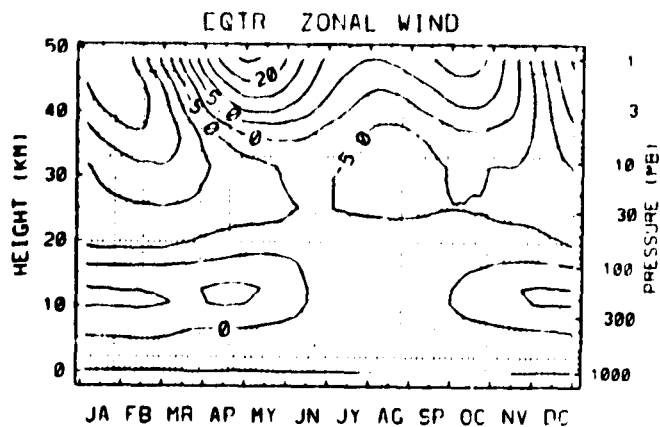
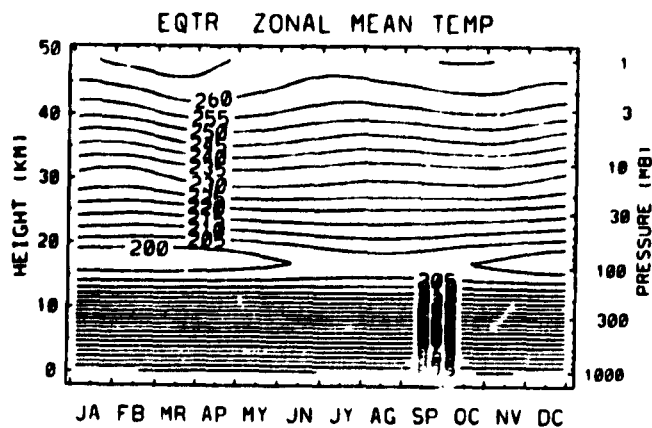
Note: The time axis has been modified for the Northern Hemisphere diagrams to run from July-June (i.e., NH winter is in the middle). Geopotential heights amplitude contours are 20 m below 50 mb, and 60 m above 50 mb.

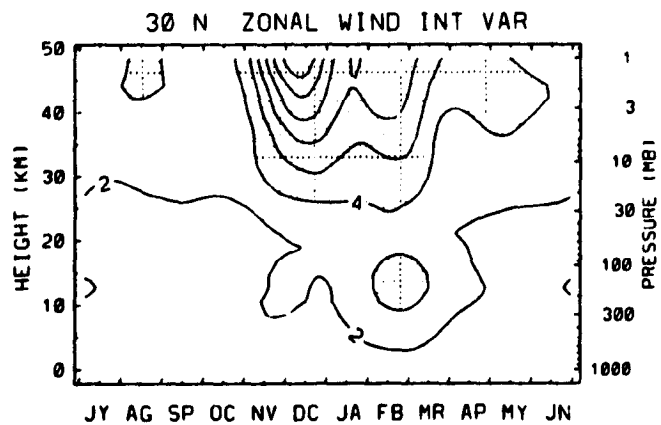
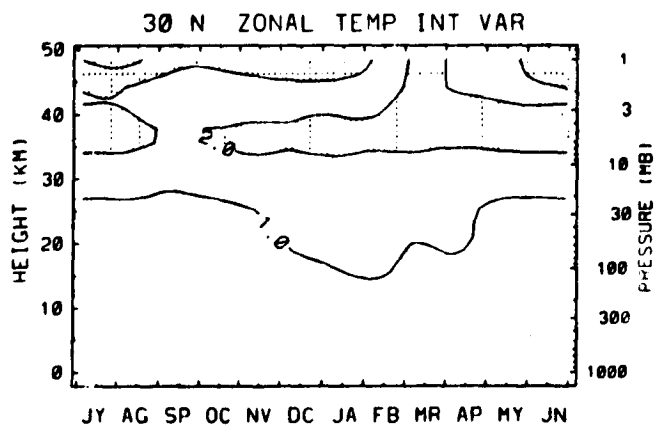
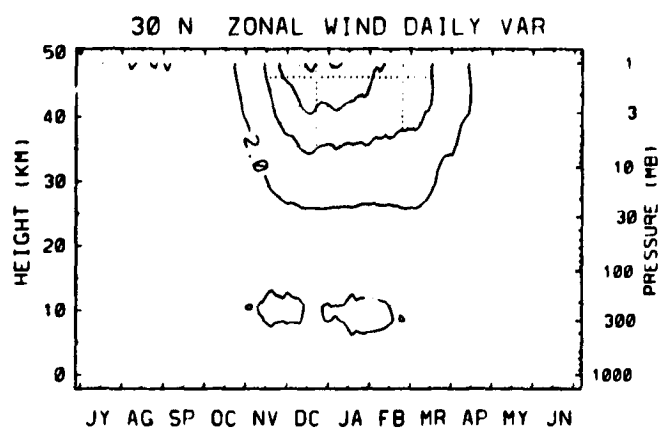
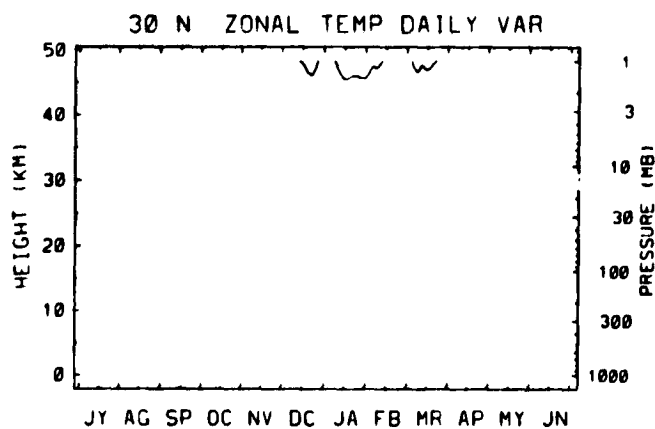
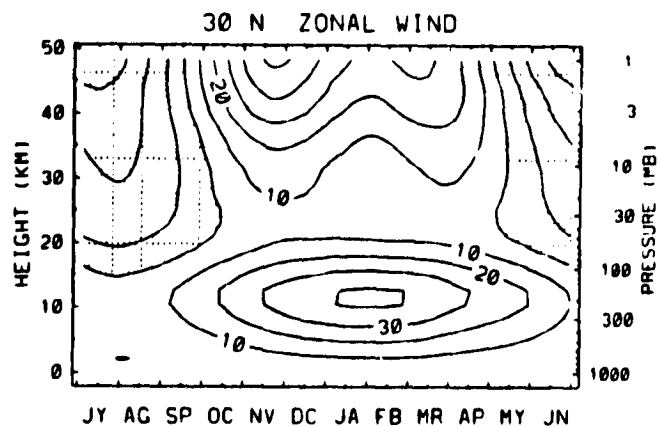
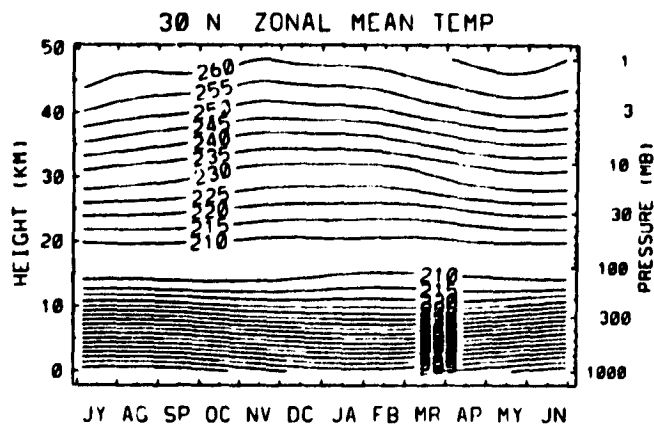


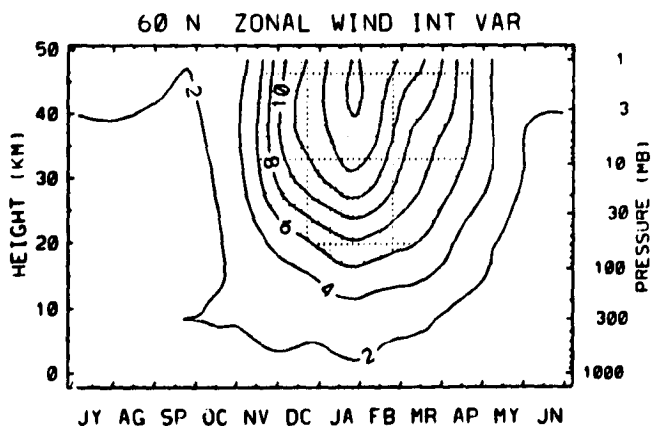
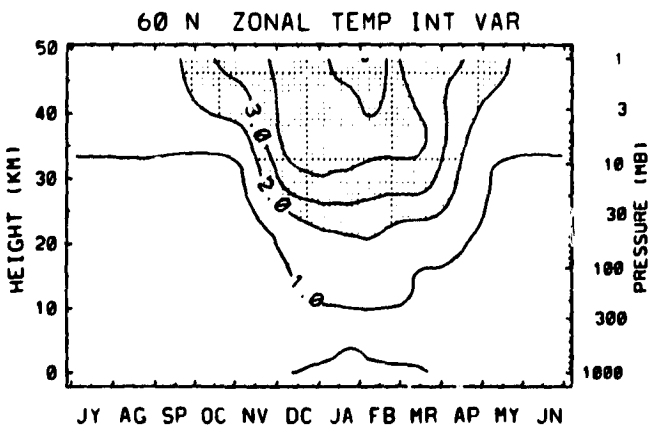
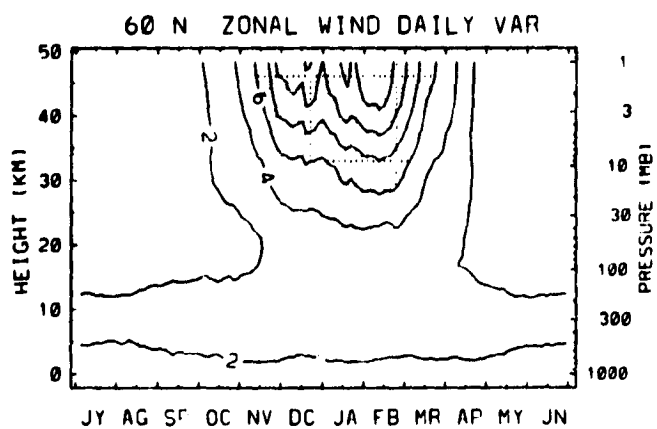
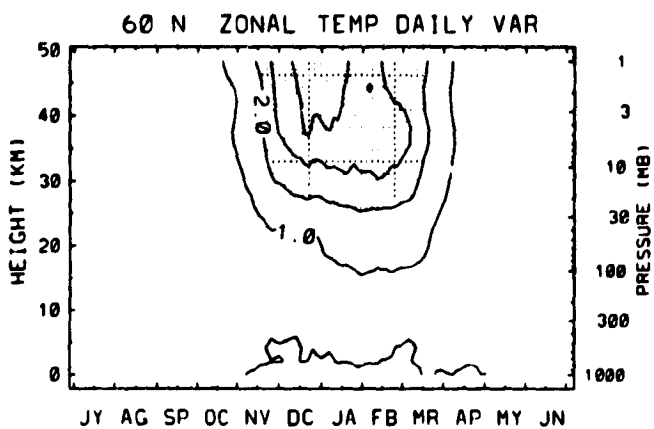
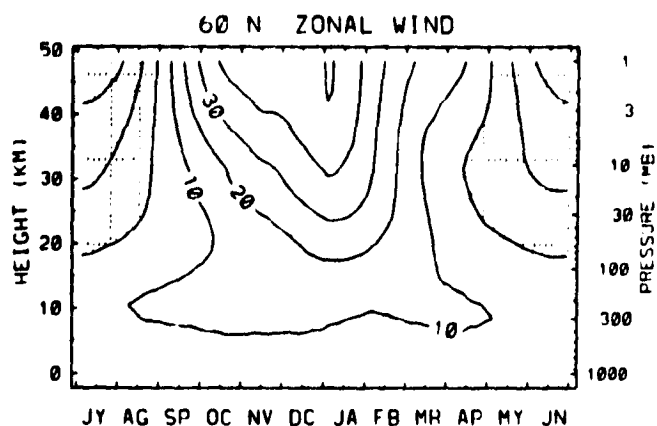
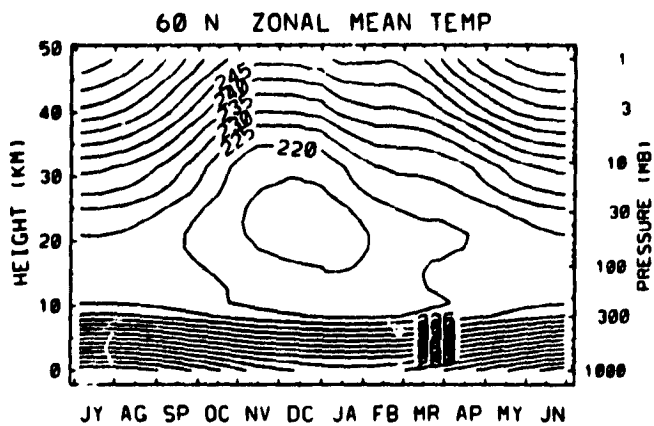
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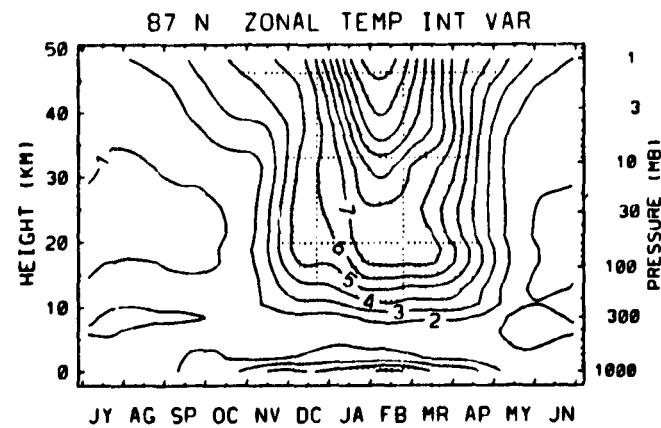
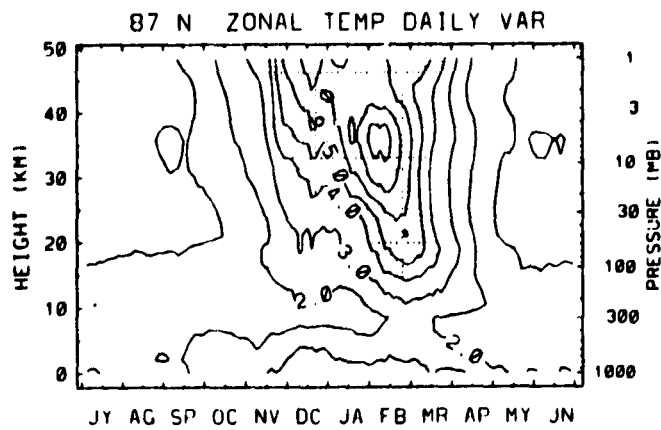
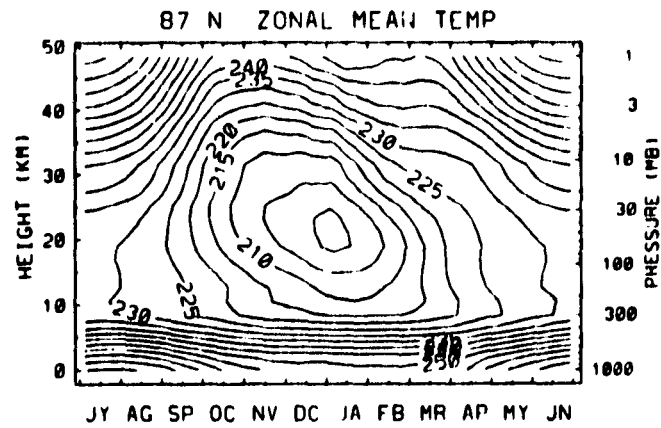


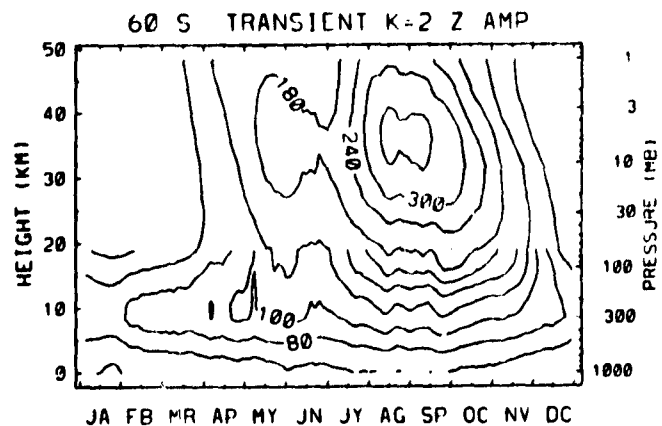
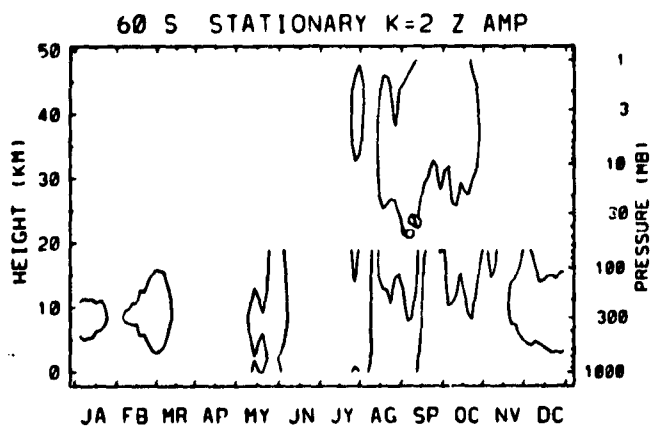
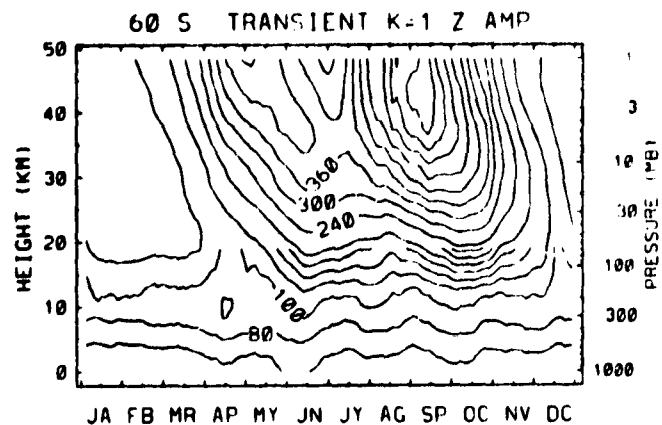
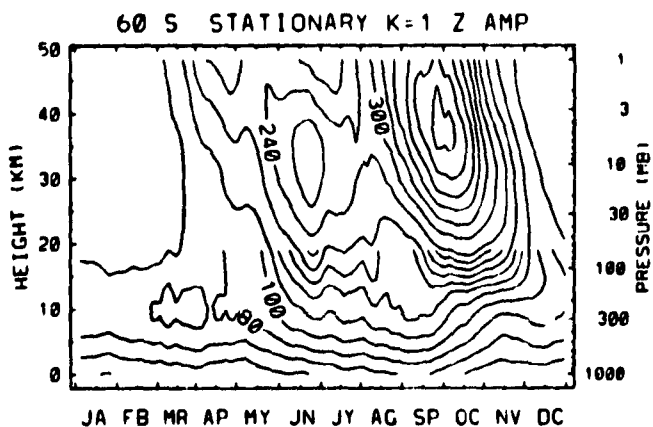
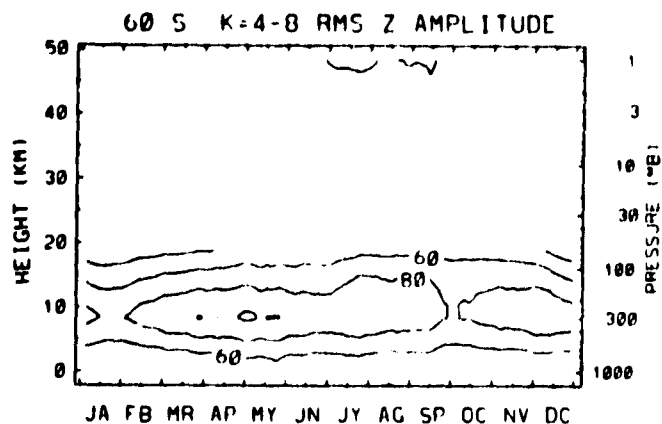
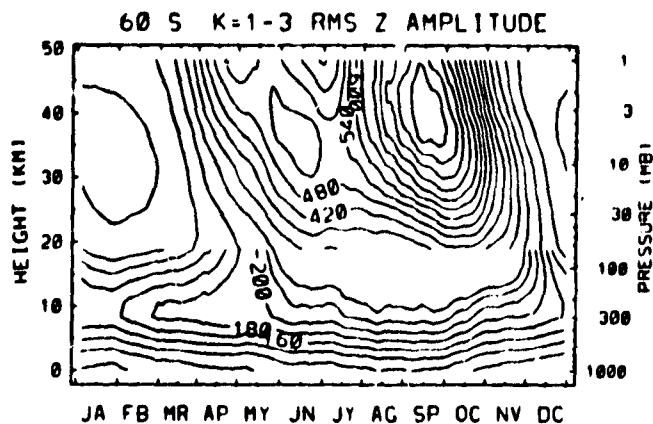


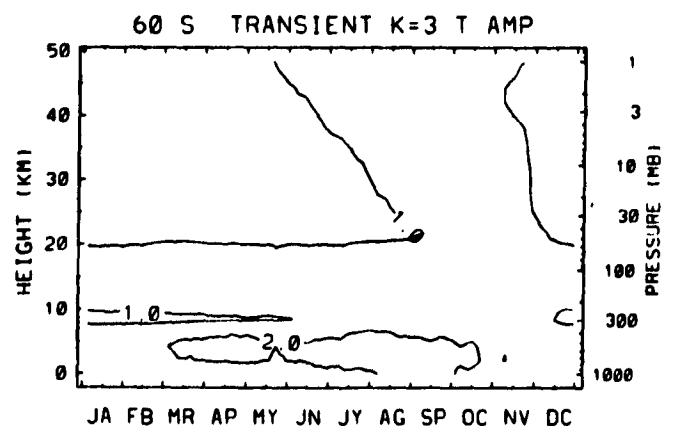
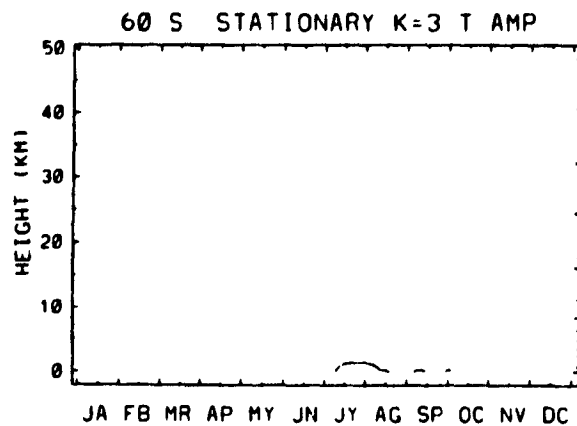
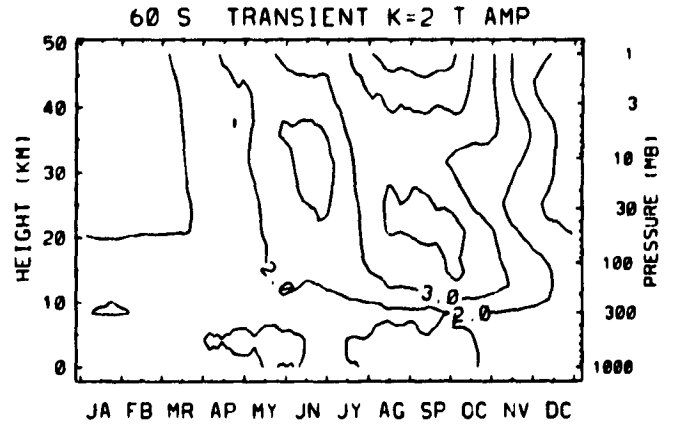
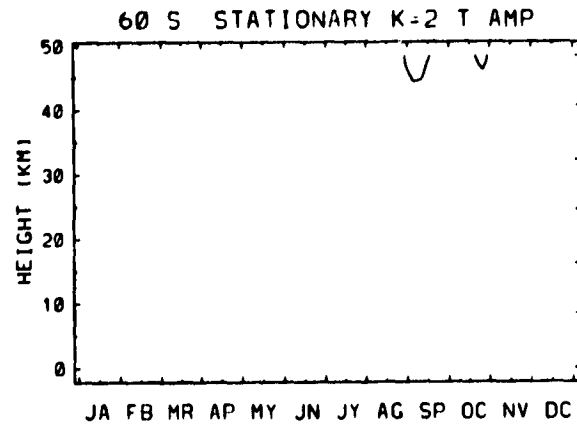
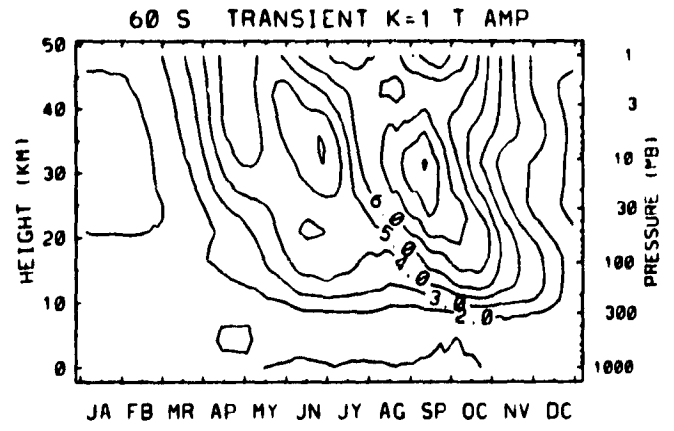
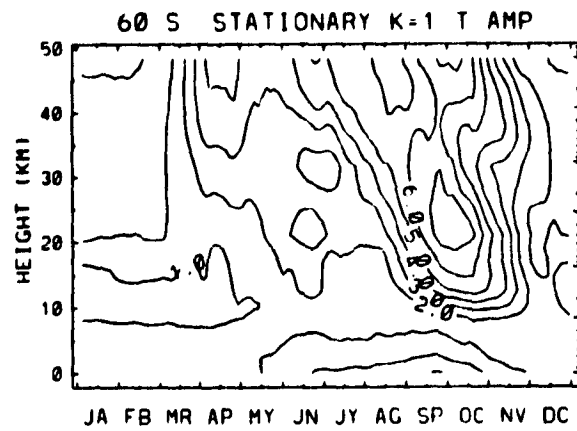
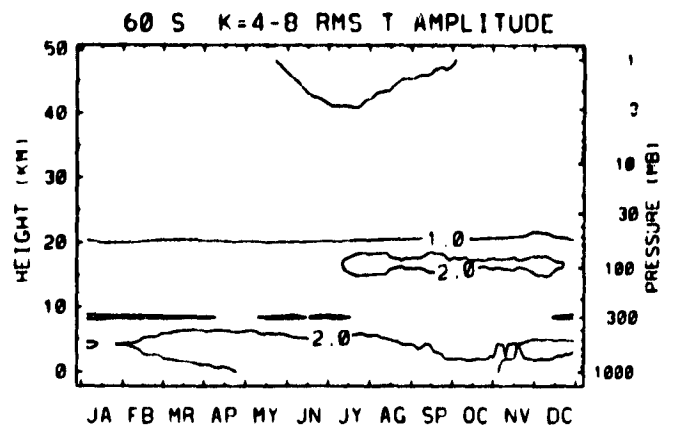
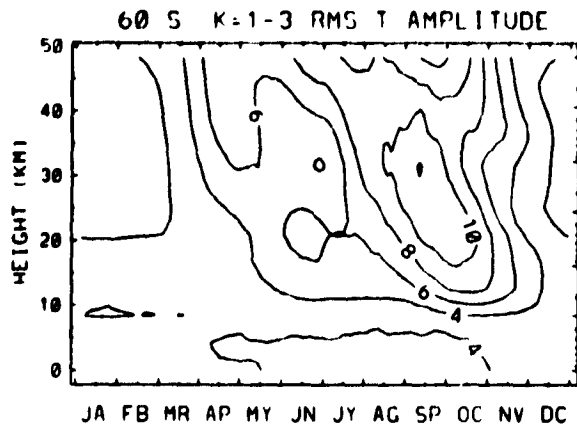


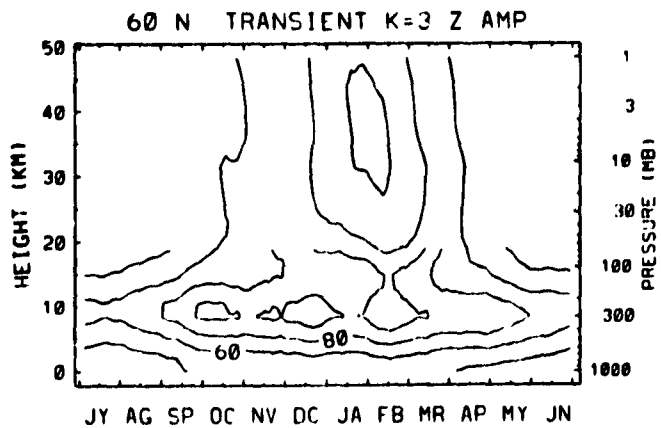
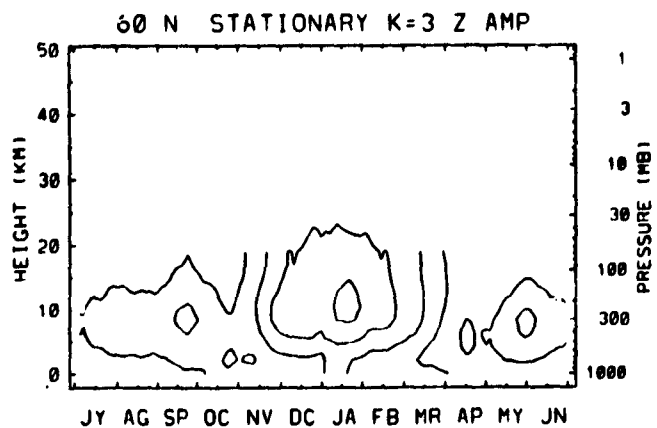
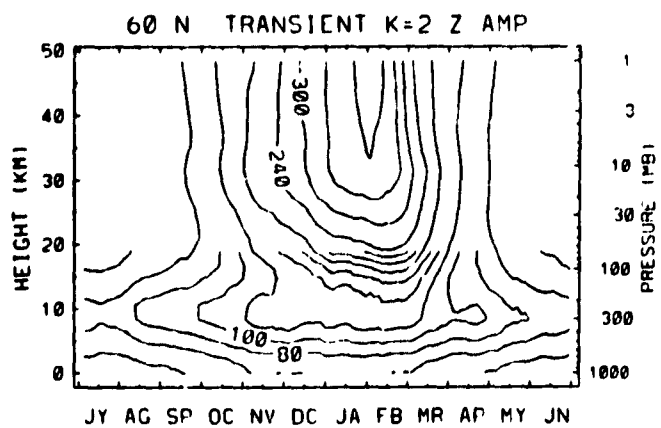
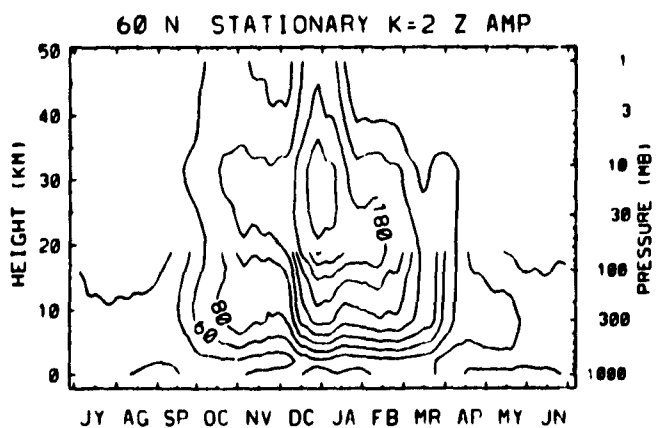
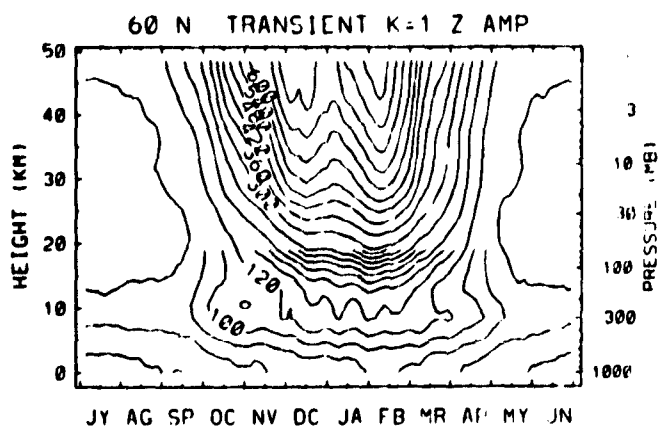
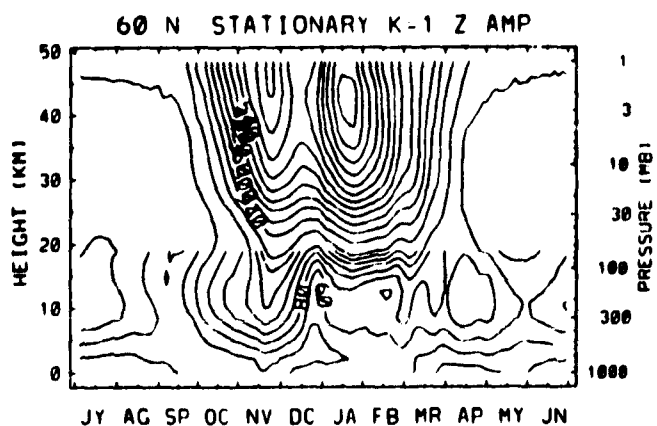
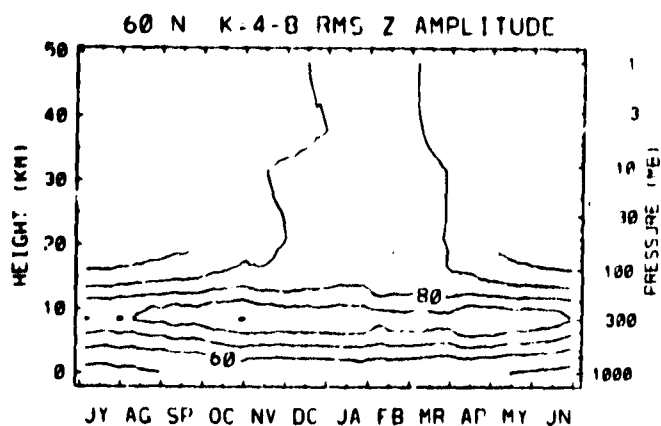
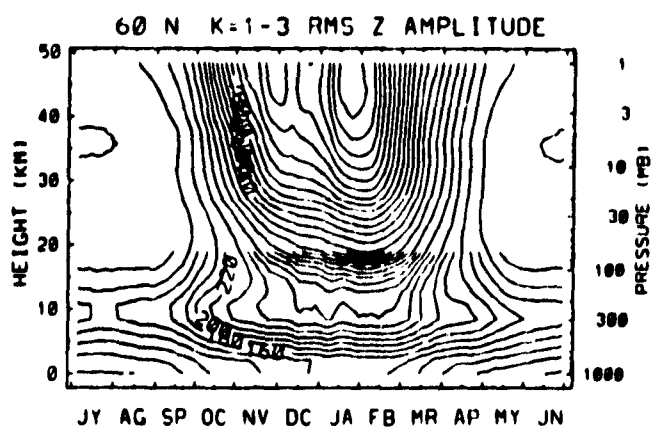


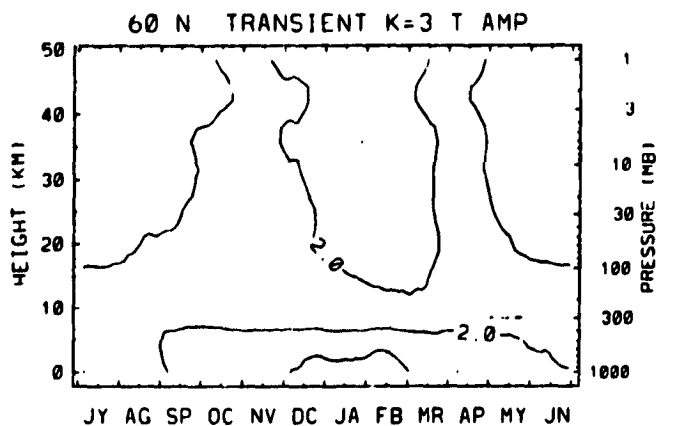
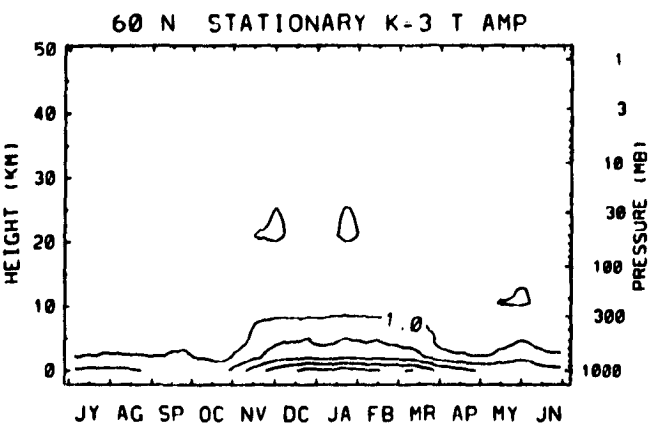
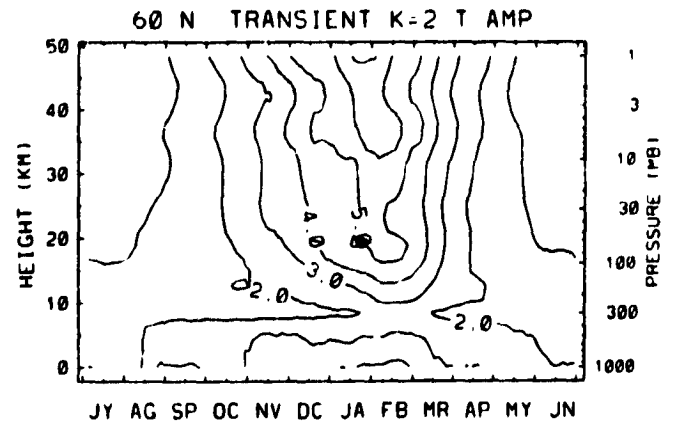
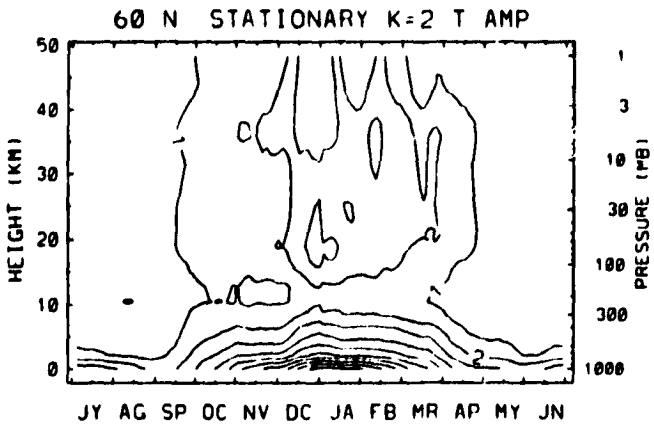
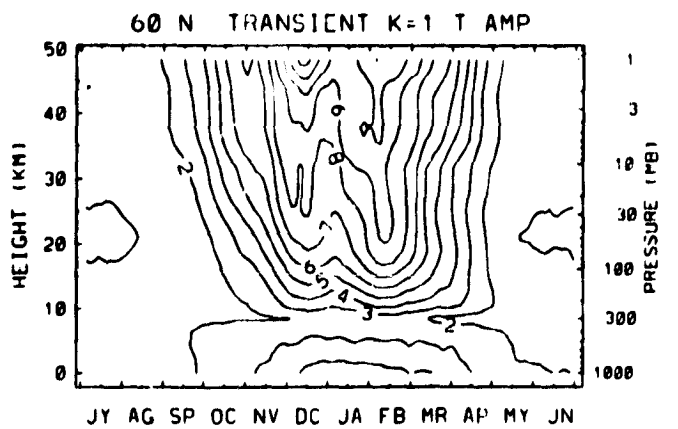
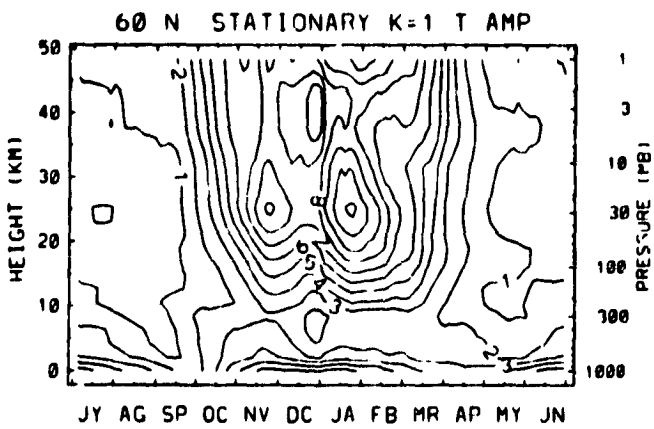
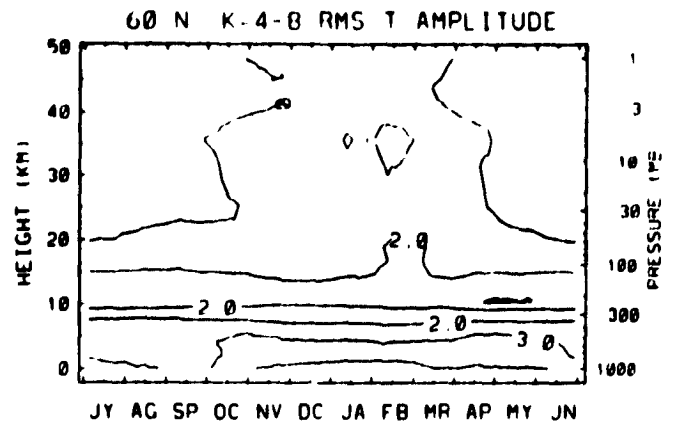
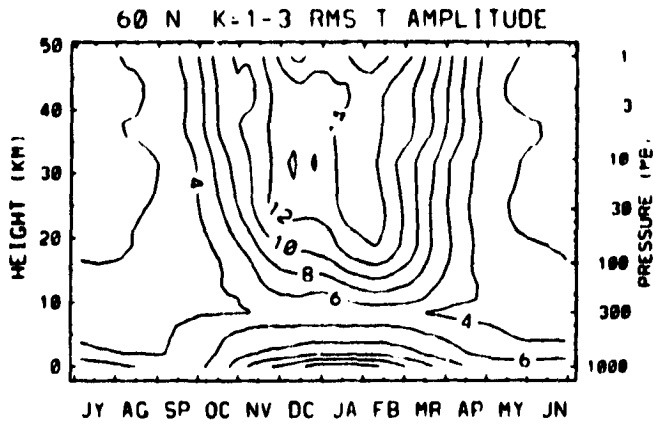






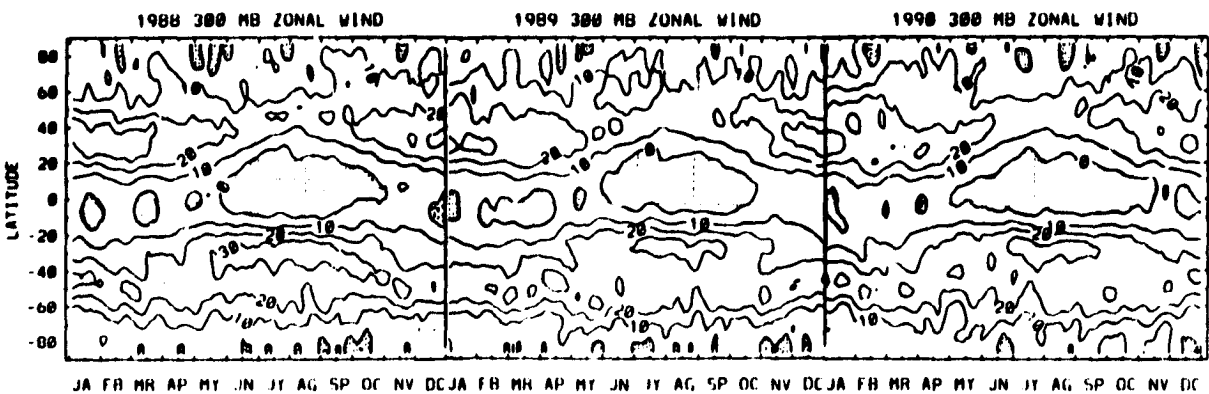
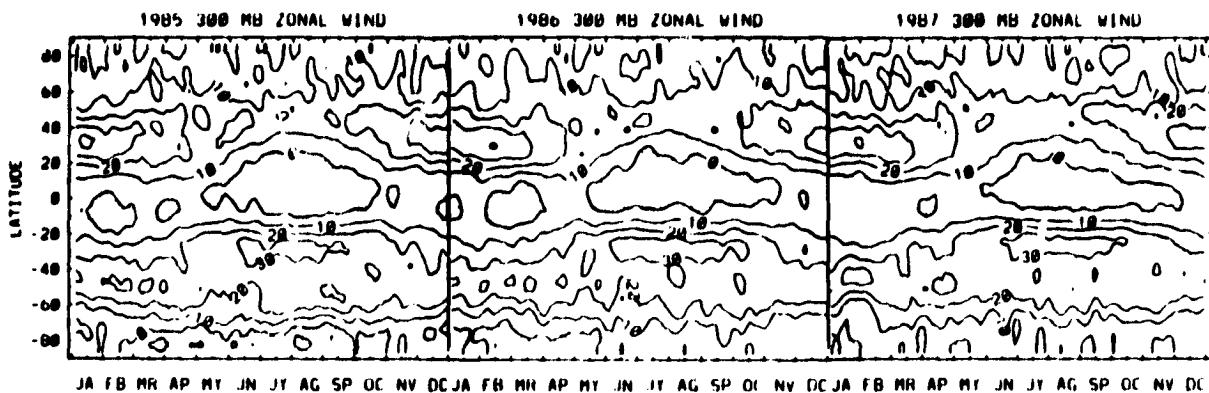
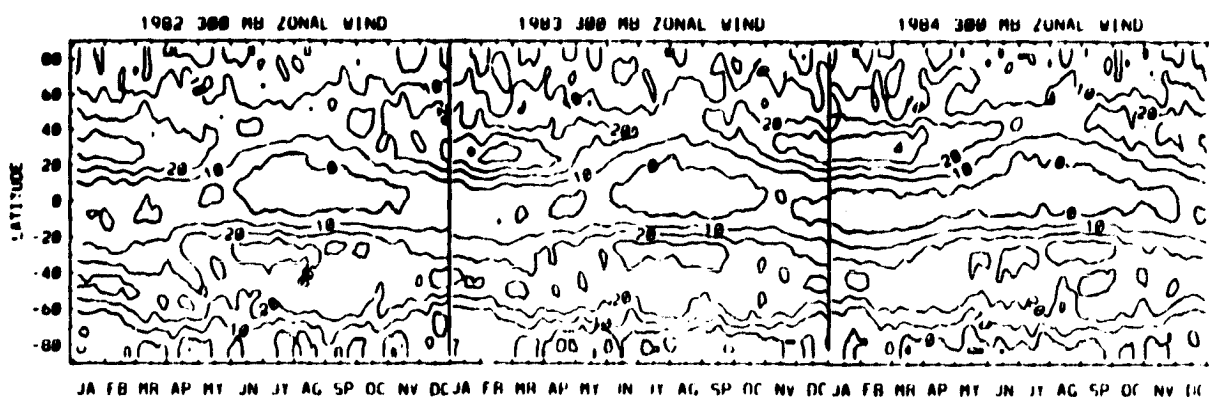
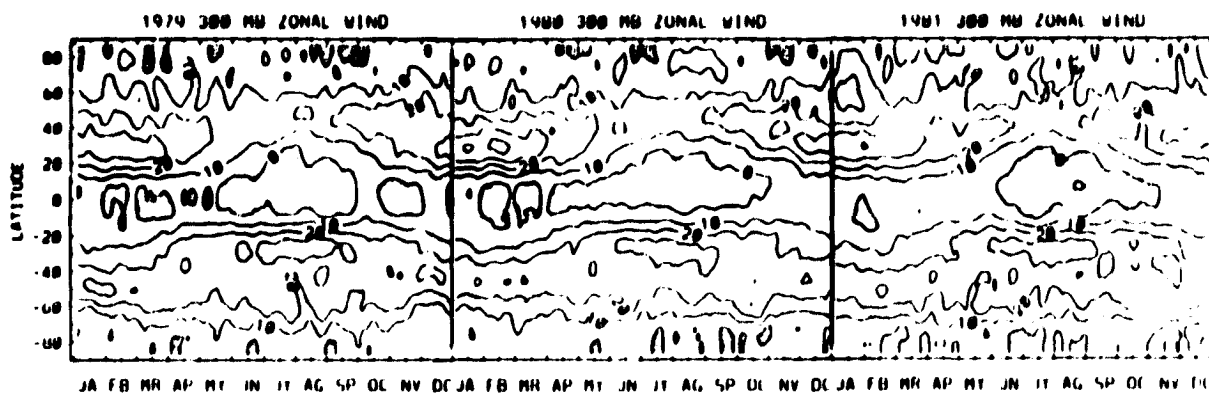


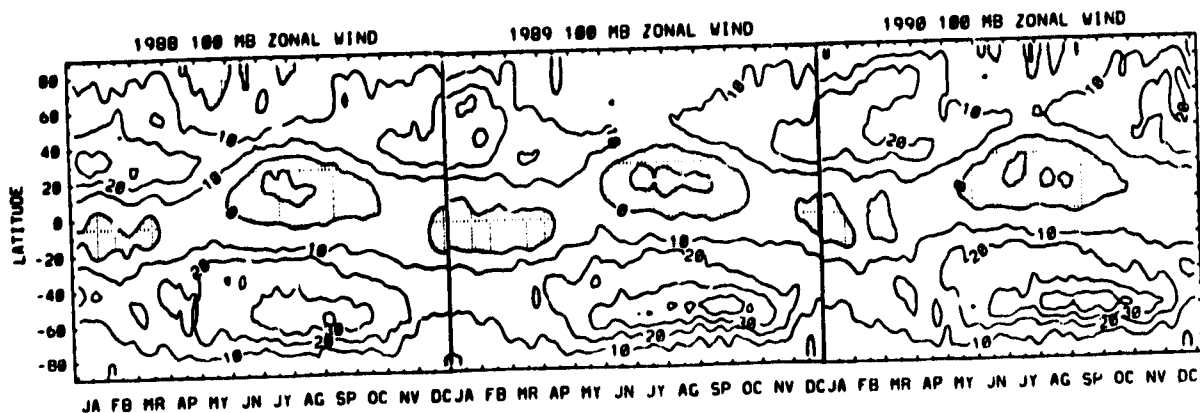
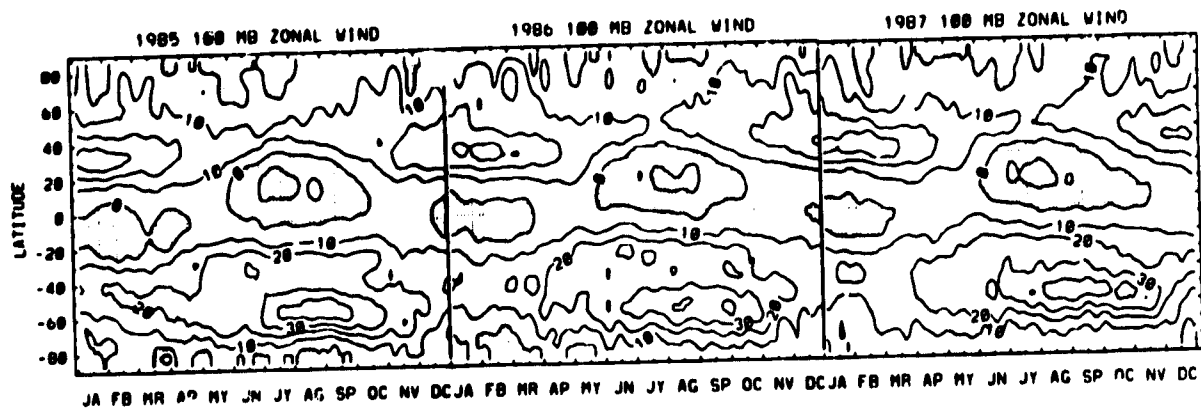
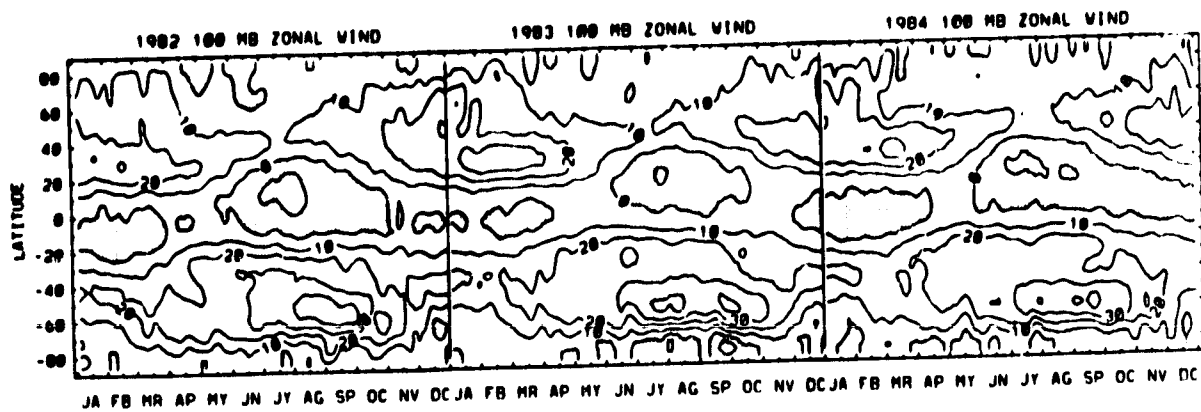
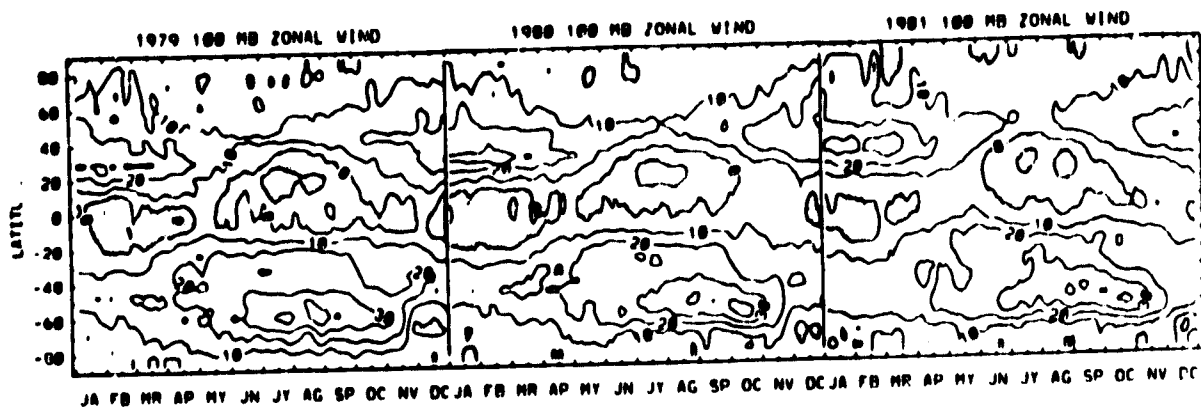


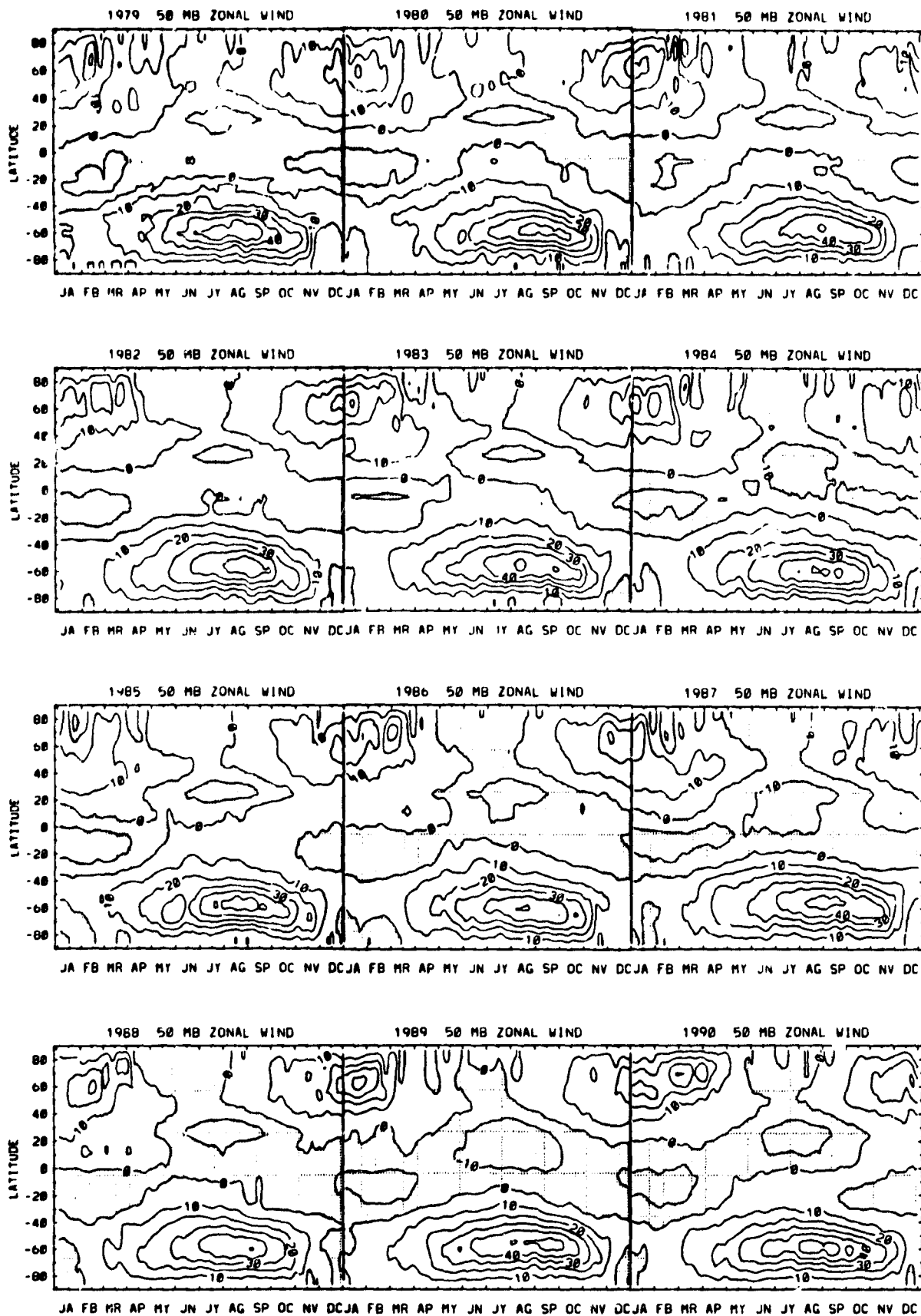


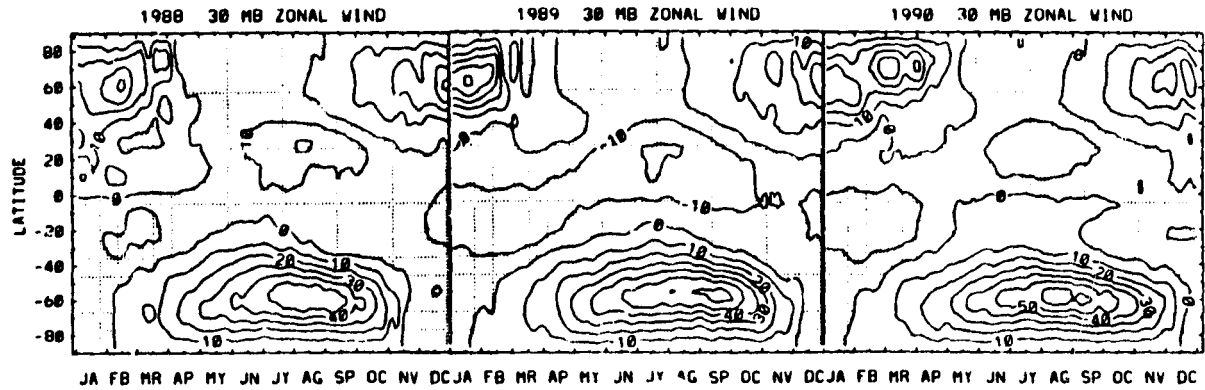
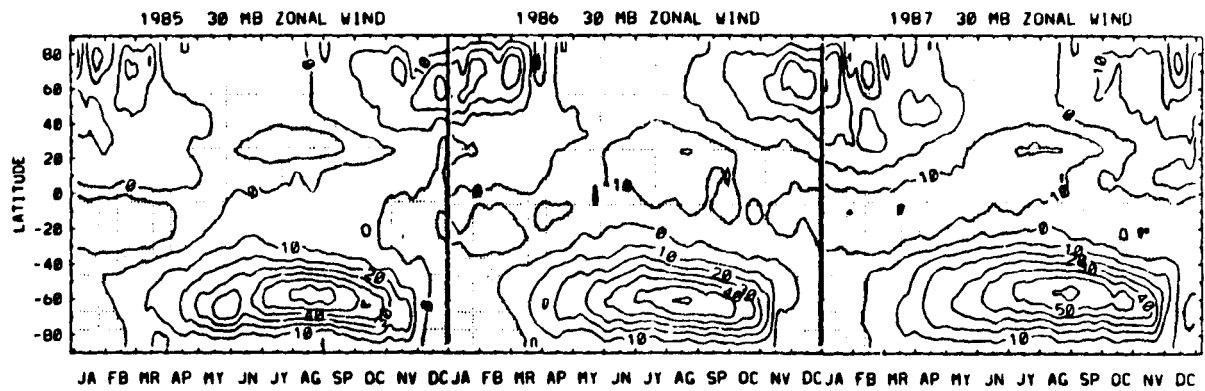
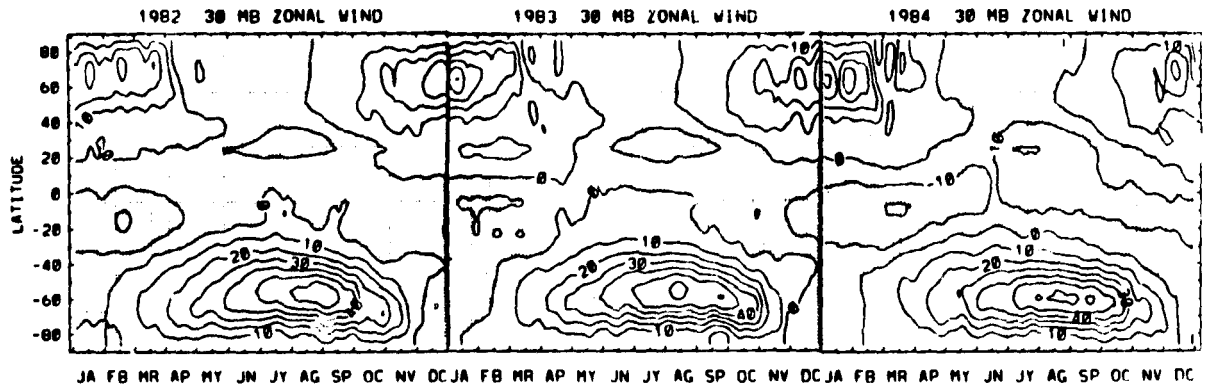
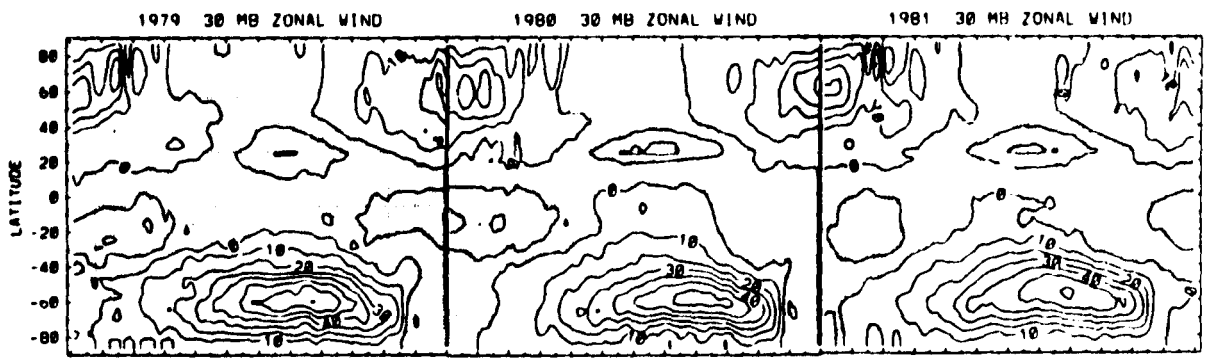
**LATITUDE-TIME AND HEIGHT-TIME DIAGRAMS OF ZONAL WINDS AND RMS
GEOPOTENTIAL HEIGHT WAVE AMPLITUDES FOR INDIVIDUAL YEARS
1979-1990**

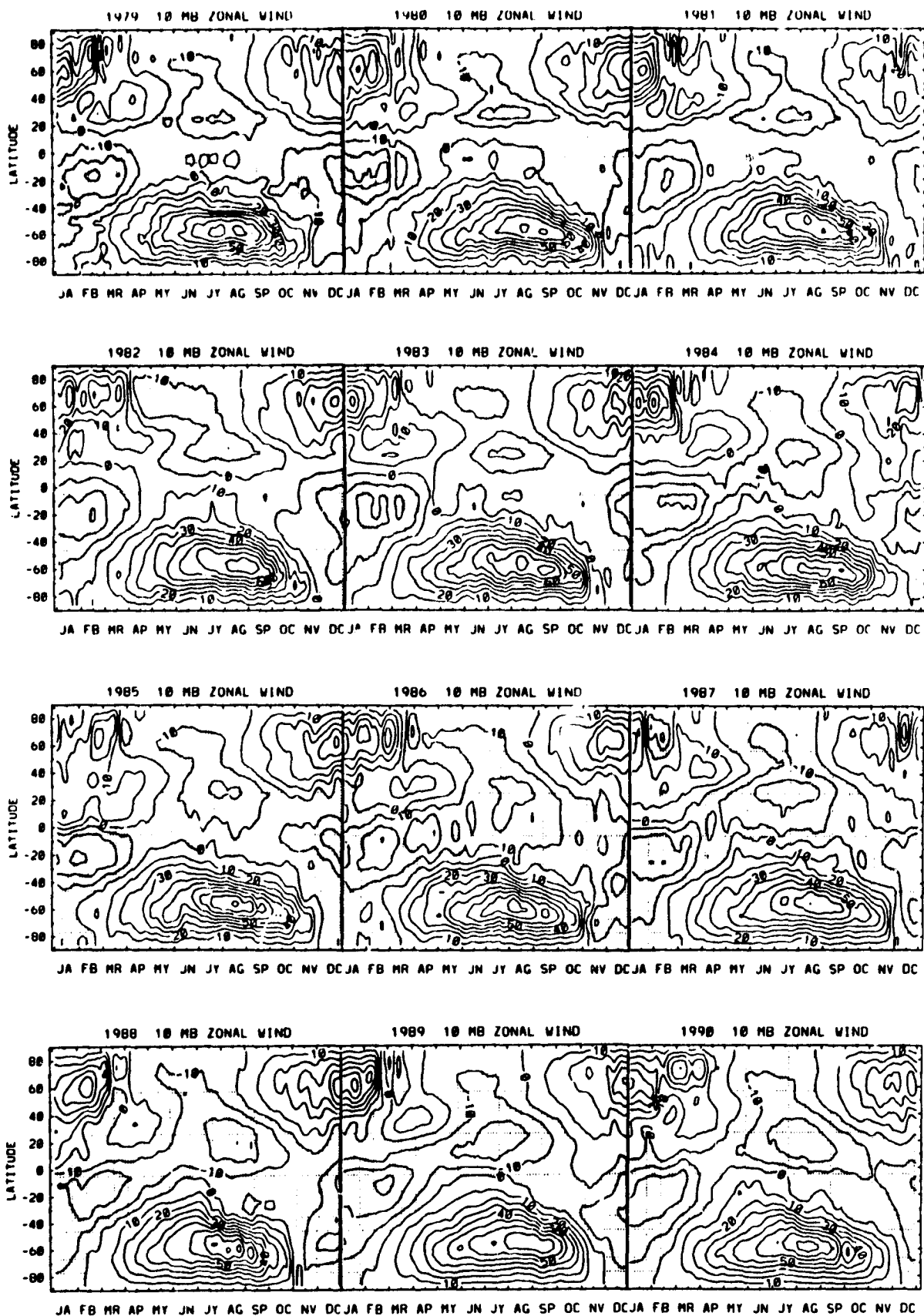
Note: These diagrams have been constructed using three-day non-overlapping mean values. They are included to show seasonal cycles and actual daily variability.

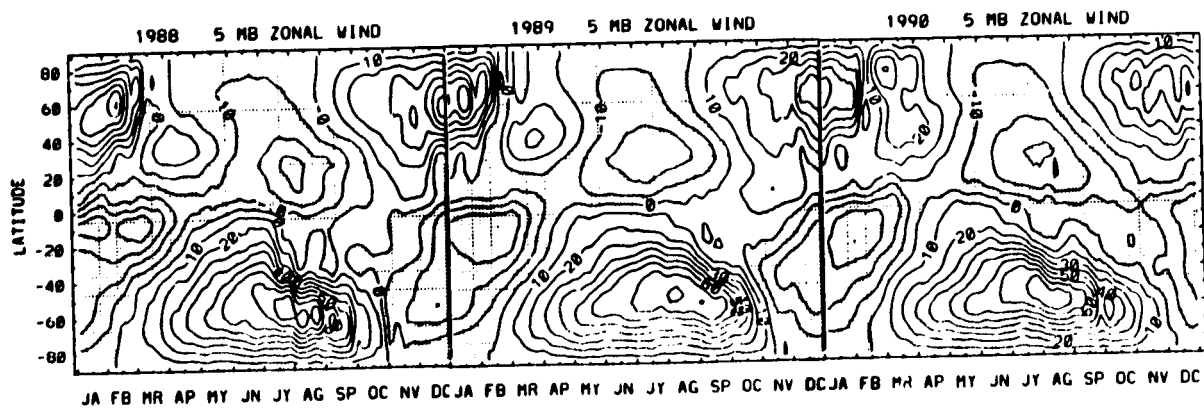
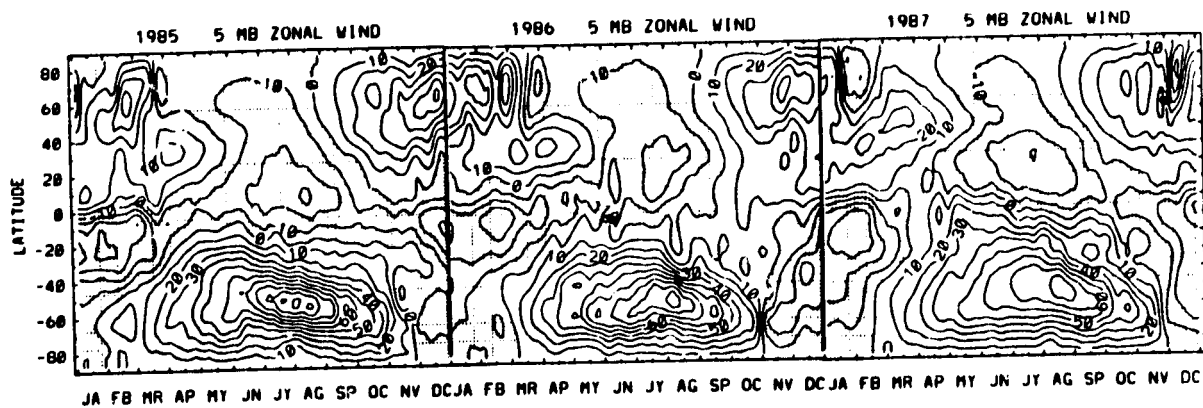
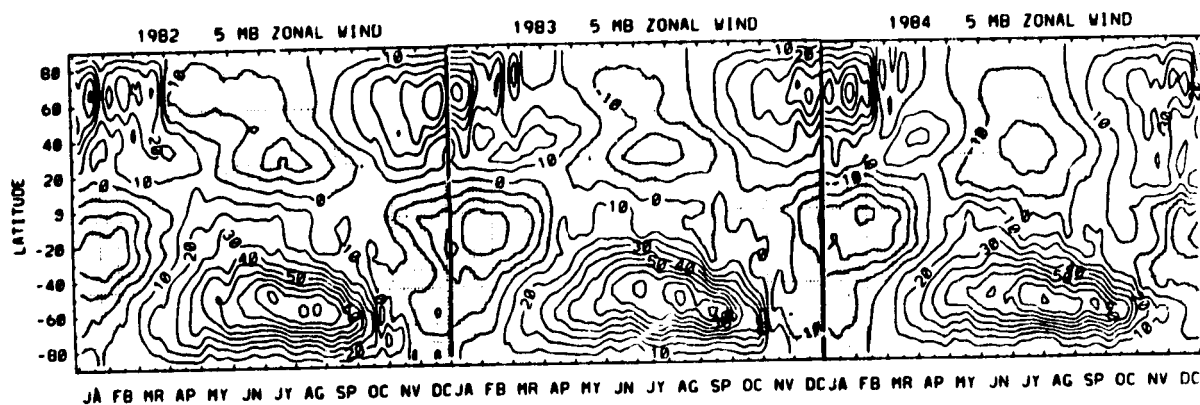
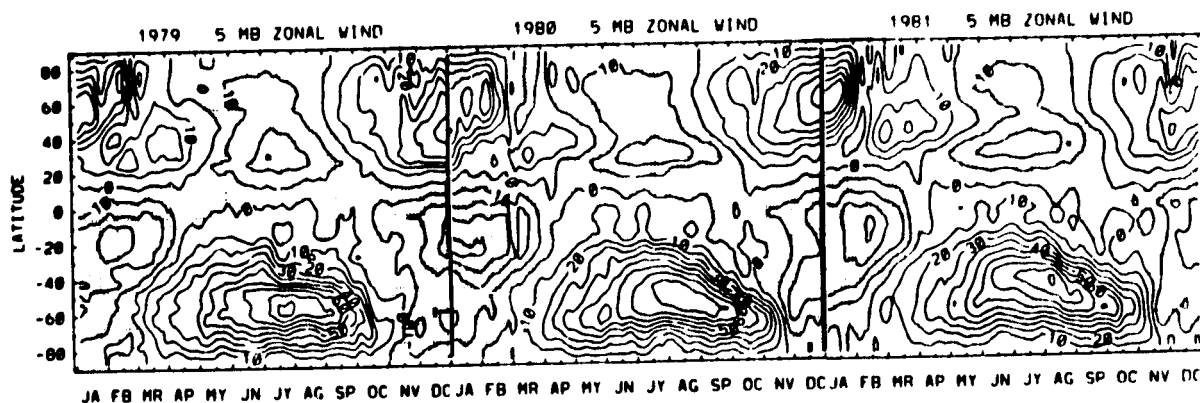


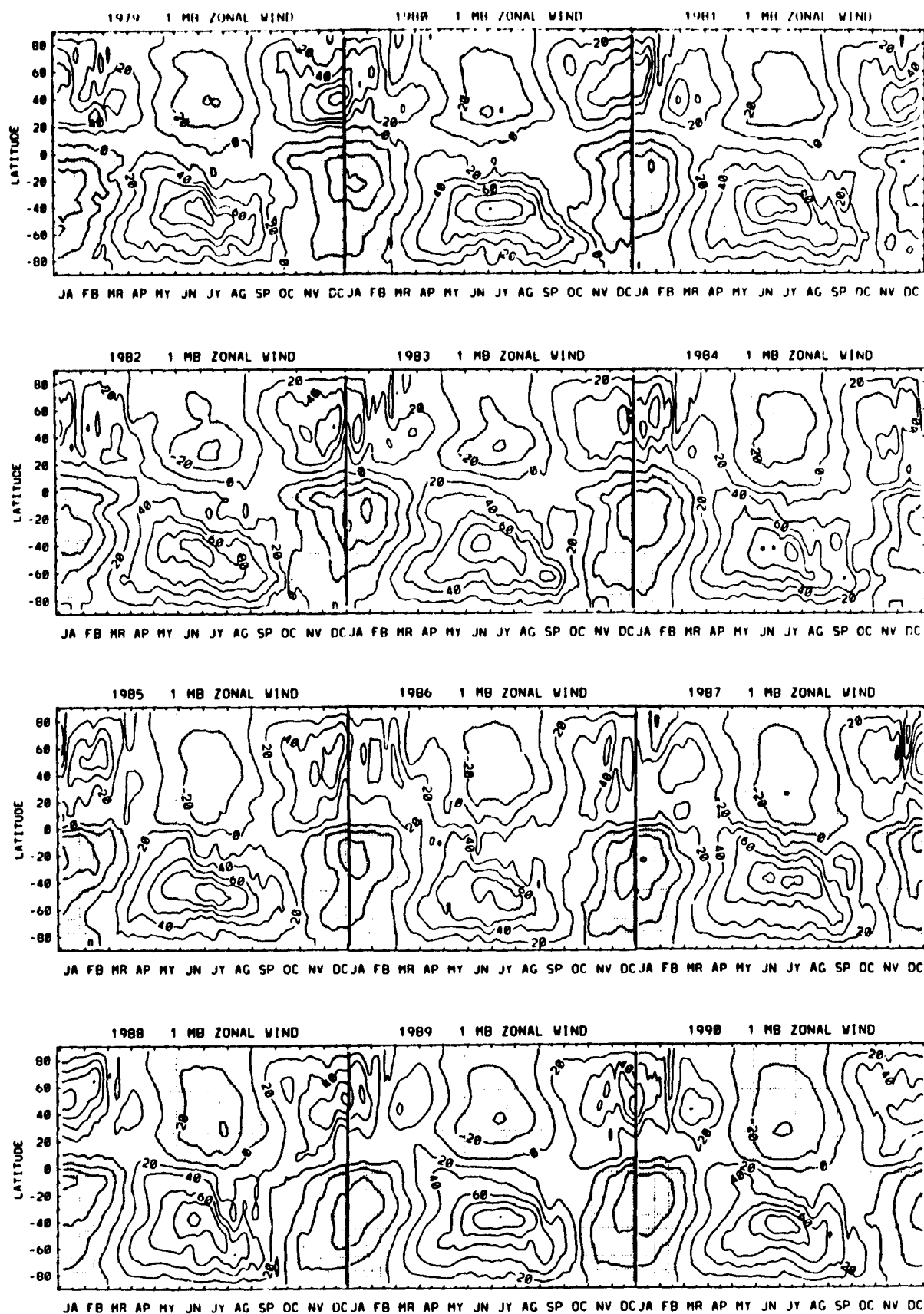


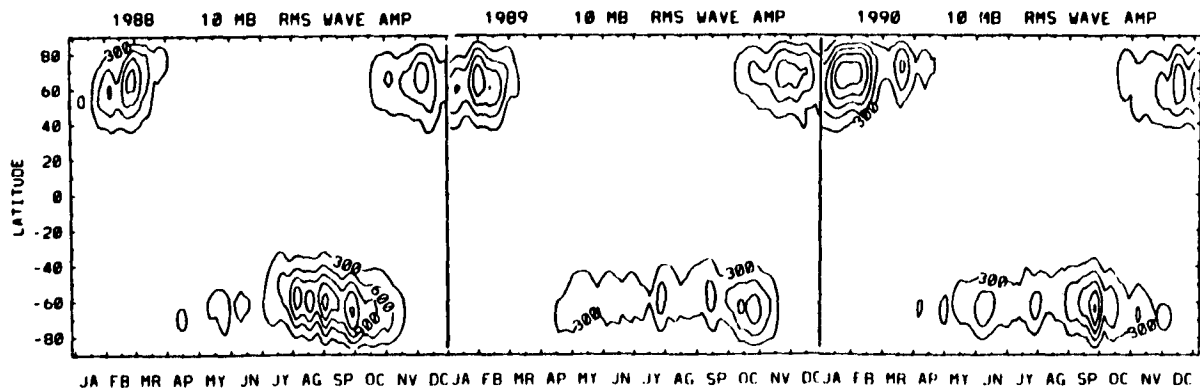
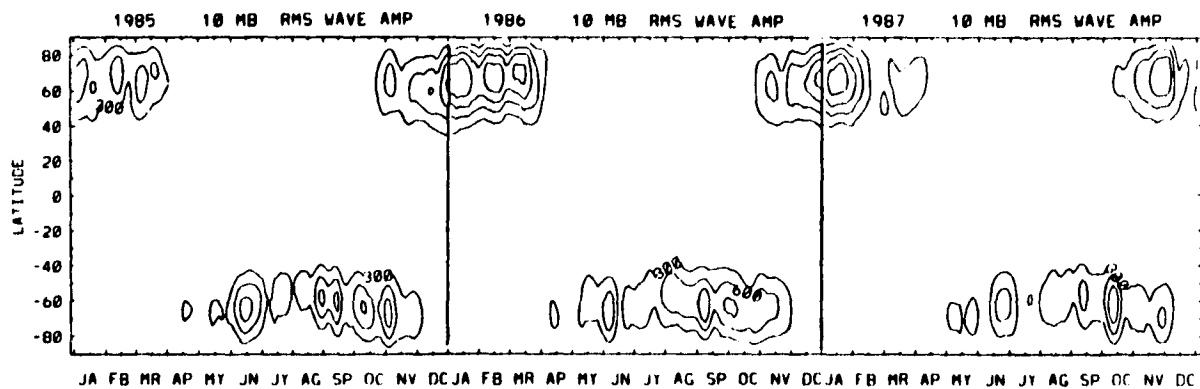
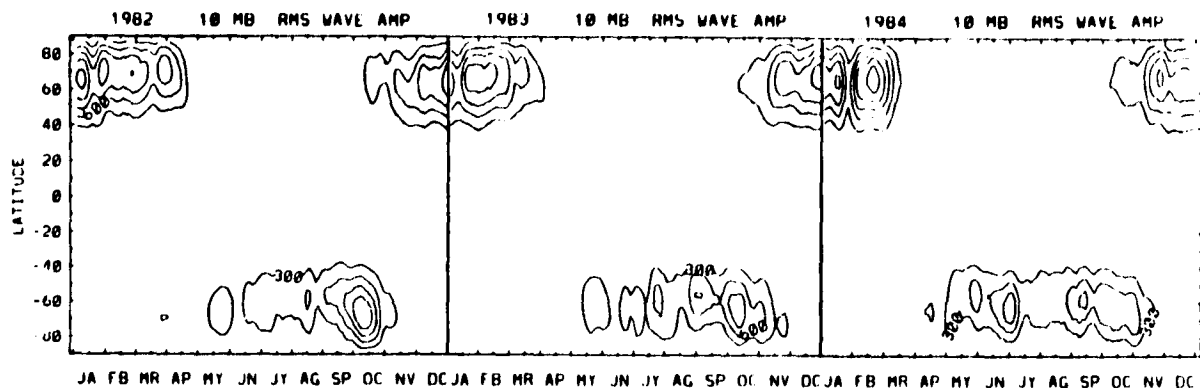
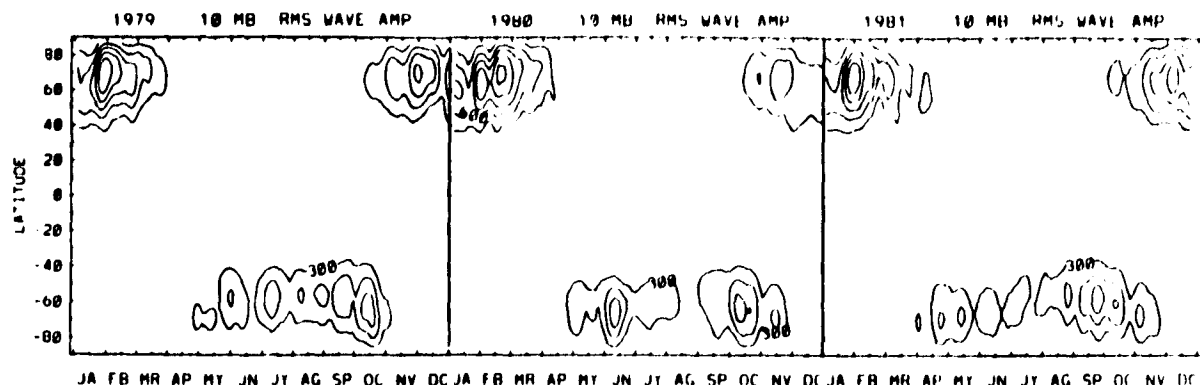


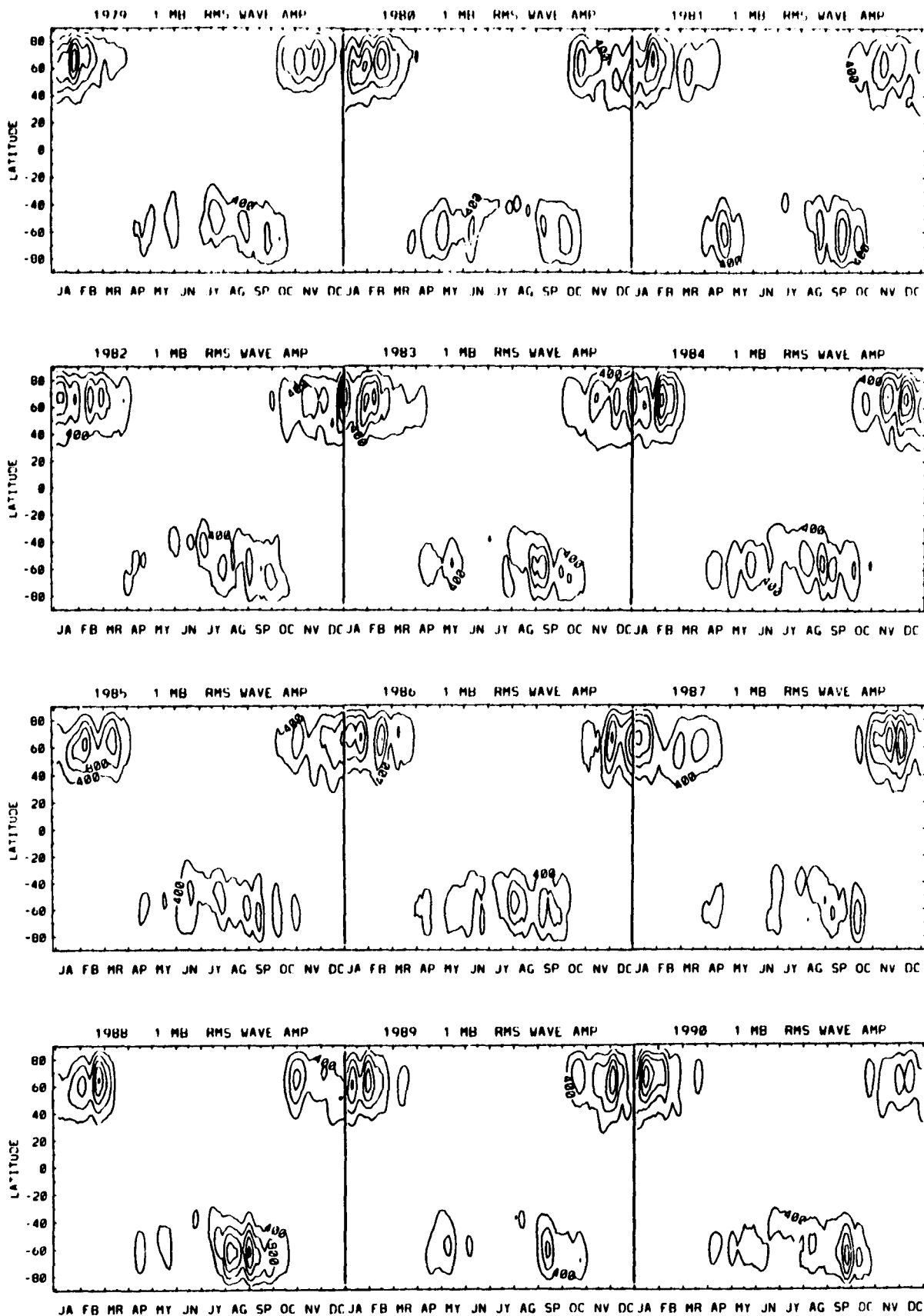


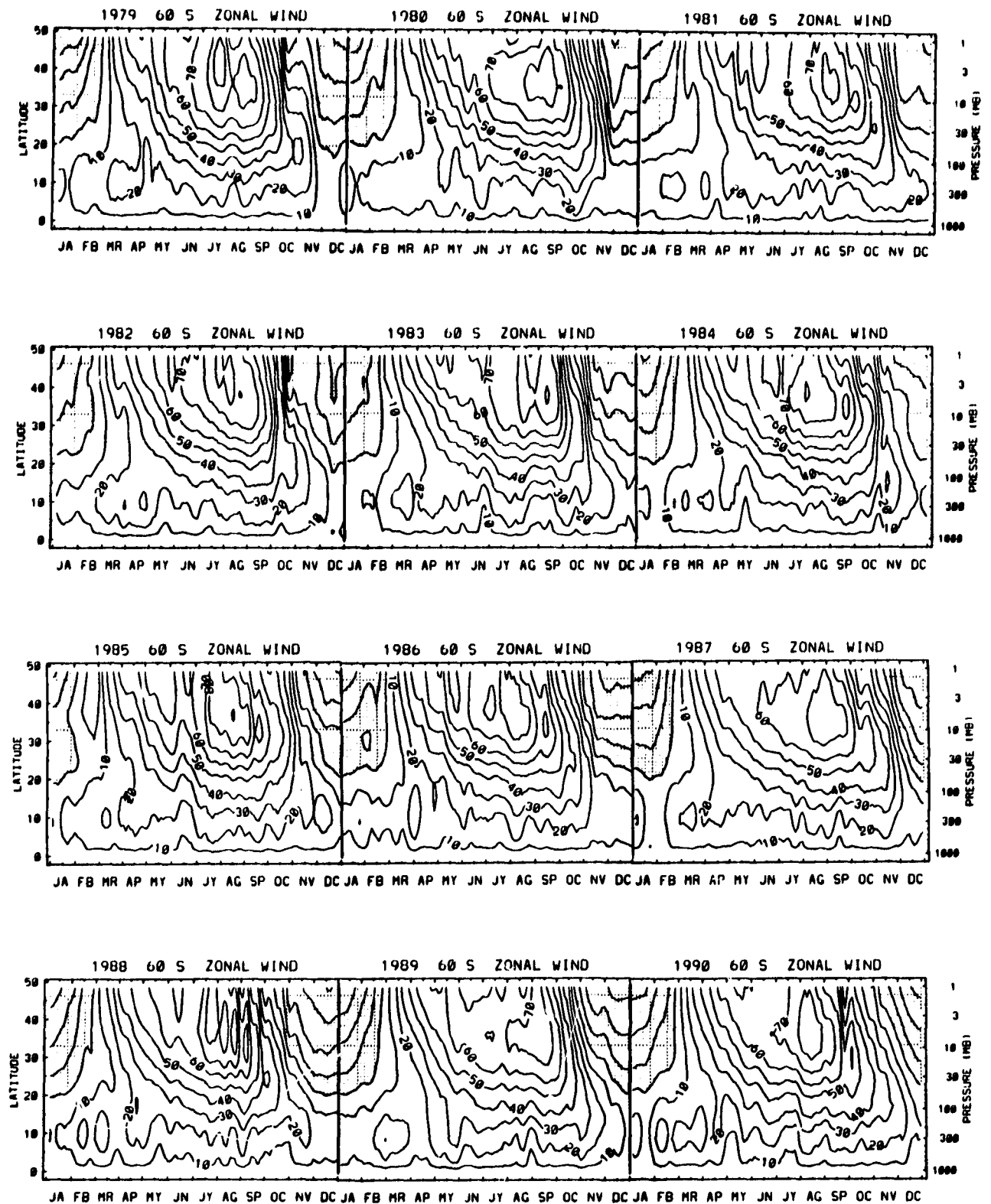


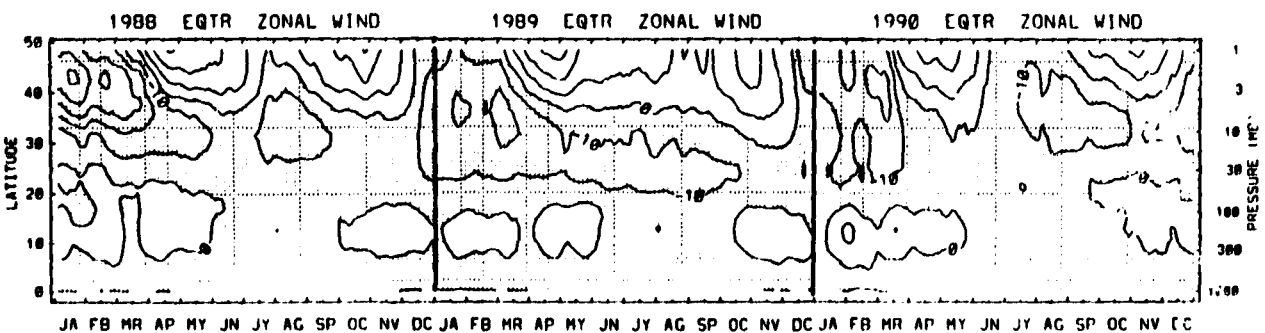
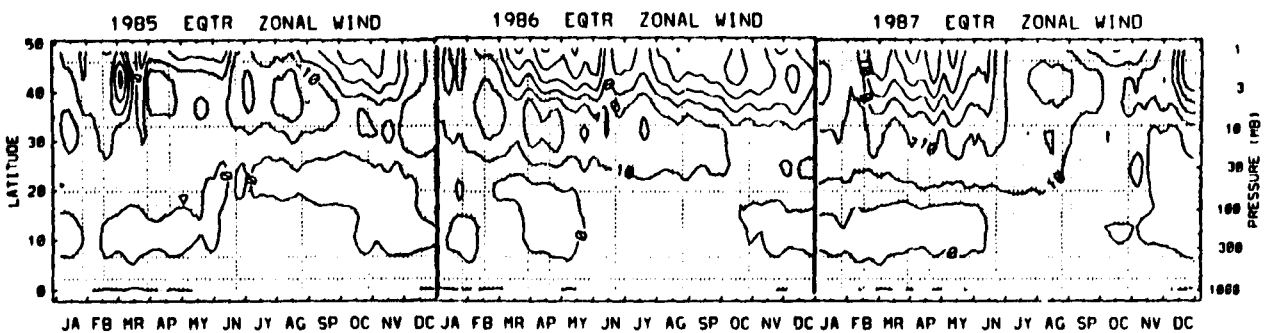
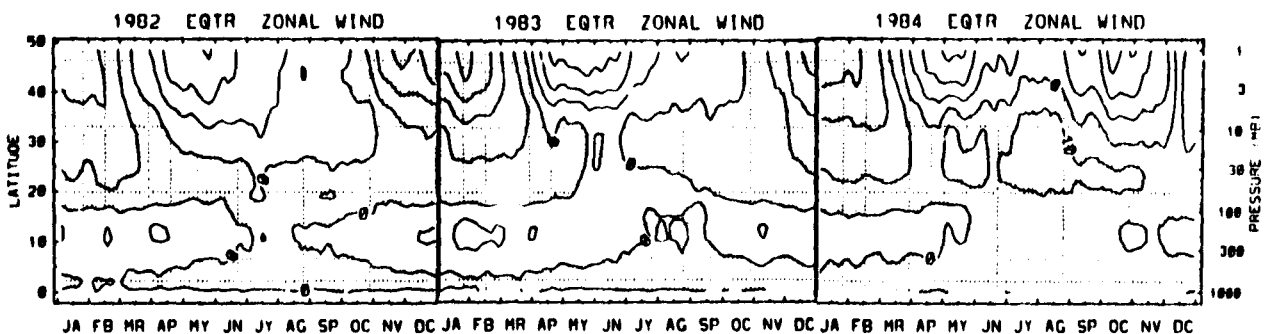
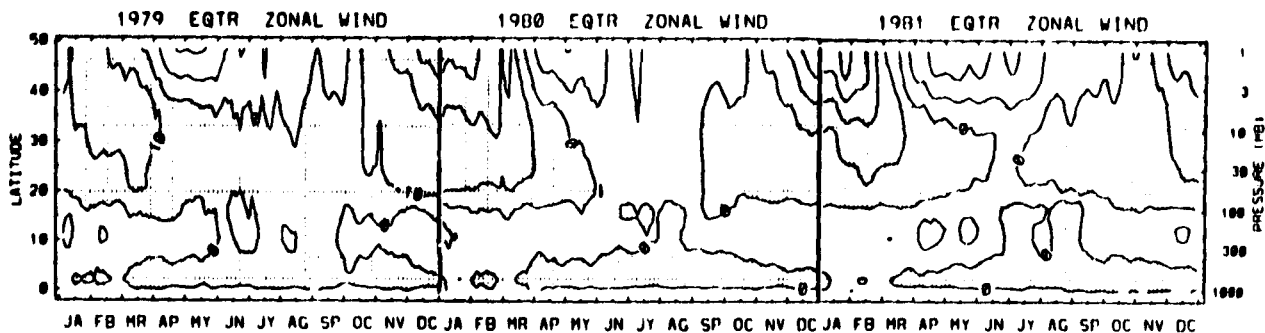


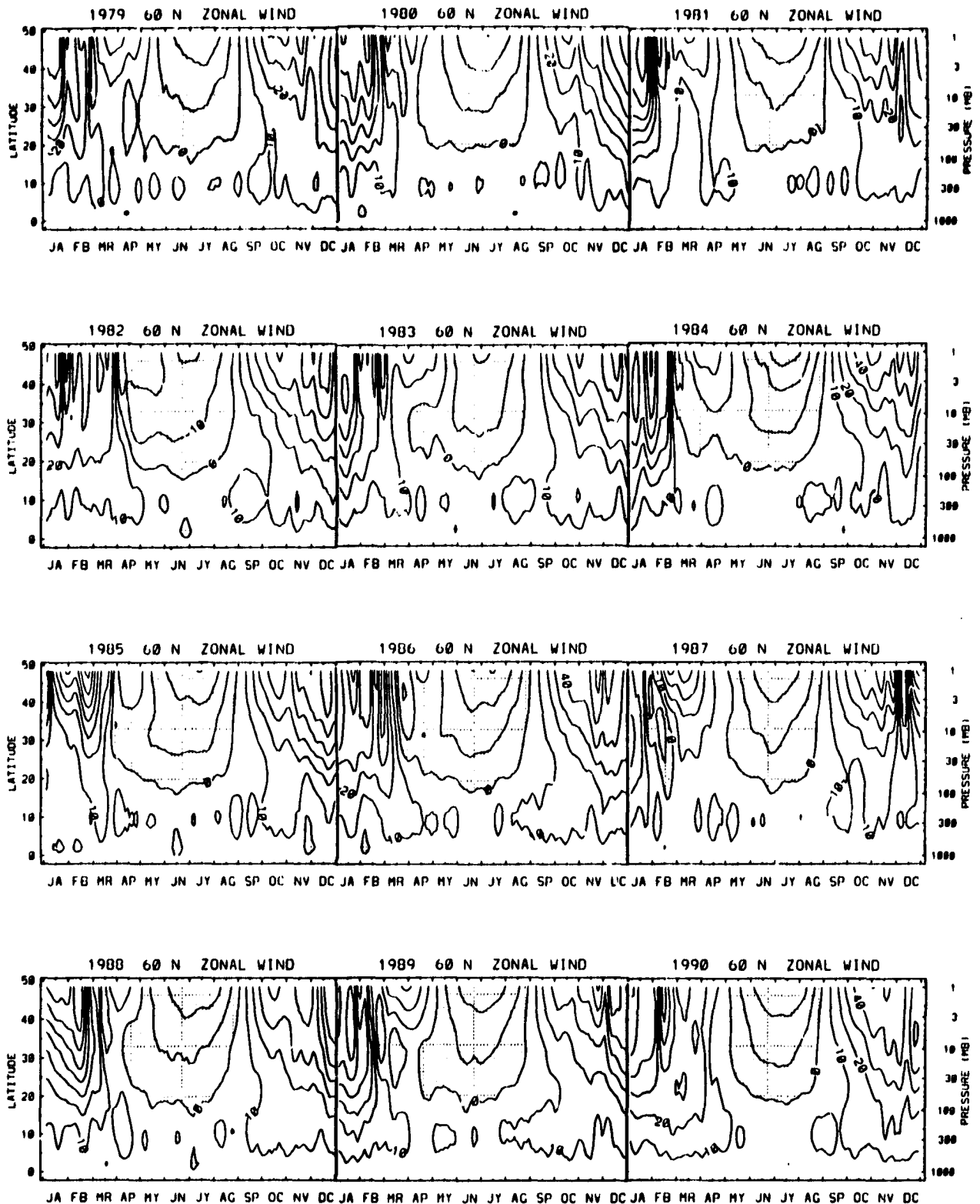












TABLES OF MONTHLY MEAN ZONAL MEAN TEMPERATURES AND WINDS

JANUARY MEAN ZONAL TEMPERATURE

290	289	288	285	283	281	279	277	275	273	270	268	266	265	265	265	264	264	264	263	262	261	259	257	254	252	251	251	252	253	254	254	1			
279	278	277	276	274	272	271	269	267	265	263	261	260	259	258	257	257	256	256	255	255	253	251	249	246	244	243	242	242	242	242	242	242	2		
261	261	260	259	258	257	256	254	252	251	249	248	246	245	244	243	242	242	242	241	241	240	238	236	234	232	230	229	228	227	226	225	225	5		
248	248	247	246	246	244	243	241	240	238	237	235	234	233	232	231	231	230	230	230	230	229	228	227	225	224	222	220	218	217	215	214	213	10		
237	236	236	235	233	231	229	227	225	222	220	218	217	216	215	215	215	215	215	215	215	216	217	217	218	217	216	213	210	207	205	203	202	30		
235	235	234	232	231	229	226	223	219	216	213	210	209	207	206	206	205	206	206	206	208	209	212	214	216	216	215	212	209	206	203	201	200	50		
234	233	233	231	230	228	225	221	217	212	208	205	202	200	199	198	198	198	198	198	199	202	205	210	214	216	216	215	213	210	206	203	201	200	70	
232	231	231	230	229	228	225	221	216	211	207	204	201	199	198	197	197	196	196	196	197	199	202	206	211	215	217	217	214	211	208	206	204	203	100	
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227	227	226	226	225	224	222	220	219	219	220	220	220	220	220	220	220	220	220	220	220	219	219	218	218	217	216	215	213	212	211	210	209	200		
224	224	224	225	225	225	225	225	225	226	227	229	230	231	231	231	232	232	231	231	230	228	226	223	220	219	218	217	215	214	213	212	211	211	250	
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263	264	265	266	267	269	272	275	279	283	286	289	291	292	292	292	292	292	292	291	290	288	285	281	277	273	268	264	261	259	255	254	252	251	850	
271	272	273	274	276	278	281	285	289	292	295	297	299	299	299	299	299	299	299	298	297	295	291	288	284	279	273	268	266	262	257	256	255	252	251	1000

LATITUDE

-85 -80 -75 -70 -65 -60 -55 -50 -45 -40 -35 -30 -25 -20 -15 -10 -5 0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85

JANUARY MEAN ZONAL WIND

-3	-8	-13	-17	-21	-25	-29	-32	-36	-41	-46	-49	-51	-52	-51	-47	-34	-15	2	11	13	17	22	27	35	41	46	48	47	44	40	34	27	19	10	1
-2	-4	-8	-12	-15	-19	-23	-25	-29	-32	-36	-39	-42	-45	-43	-32	-15	0	7	10	13	17	21	26	32	39	43	44	44	41	36	28	19	10	2	
-1	-2	-5	-8	-11	-13	-15	-17	-19	-23	-26	-29	-31	-33	-33	-31	-23	-12	-1	3	5	7	9	11	14	21	28	35	40	42	40	35	27	18	9	5
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0	0	0	0	0	1	2	2	1	-1	-5	-7	-9	-10	-10	-8	-3	0	2	3	4	6	8	11	13	17	21	24	25	23	20	15	9	4	50	
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1	2	2	3	6	10	16	22	26	25	22	17	11	7	3	1	1	3	6	11	18	26	33	38	37	30	23	19	17	14	11	9	7	4	2	150
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2	2	2	3	6	12	20	27	29	25	20	14	9	6	3	1	1	2	4	9	15	23	29	33	32	27	22	17	13	10	7	5	4	3	1	300
1	2	1	2	5	11	18	23	25	21	16	10	6	3	1	0	0	0	4	10	16	22	25	25	22	18	14	11	8	6	4	3	2	1	400	
1	1	0	0	3	9	15	20	21	18	12	7	3	0	0	-1	-2	-2	-1	0	5	11	15	18	19	18	15	12	9	6	4	3	2	1	0	500
0	0	-1	-1	1	6	11	15	15	12	7	2	0	-1	-2	-2	-3	-4	-3	0	3	6	9	10	11	10	8	6	4	2	1	1	0	0	700	
0	-1	-2	-2	0	5	9	12	11	8	4	0	-1	-2	-2	-2	-4	-5	-6	-4	-1	1	2	5	6	6	5	4	2	1	0	0	0	850		
0	-1	-3	-3	0	3	7	9	8	5	0	-2	-3	-4	-3	-2	-2	-5	-7	-9	-8	-6	-3	0	1	1	2	3	2	0	0	0	-1	0	1000	
85	-80	-75	-70	-65	-60	-55	-50	-45	-40	-35	-30	-25	-20	-15	-10	-5	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	

LATITUDE

FEBRUARY MEAN ZONAL TEMPERATURE

279	278	277	276	275	273	272	271	269	268	266	265	265	265	266	266	266	266	265	265	264	263	262	260	258	255	253	251	250	249	249	250	250	1			
267	267	266	266	265	265	264	263	262	261	260	259	259	259	259	259	258	258	258	258	257	256	255	253	250	248	246	244	243	242	242	242	243	243	2		
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240	240	240	240	239	239	238	238	238	237	236	235	234	232	232	231	231	231	231	231	230	230	229	228	227	226	226	225	225	224	224	224	224	224	10		
232	232	231	231	230	228	227	225	224	222	220	218	217	216	215	214	214	214	214	214	215	215	216	218	218	219	219	218	216	215	213	212	211	30			
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LATITUDE

FEBRUARY MEAN ZONAL WIND

0	-1	-1	-1	-2	-5	-8	-13	-19	-25	-30	-33	-34	-34	-33	-31	-23	-8	6	14	15	19	23	28	31	32	33	33	32	29	26	22	18	13	1	
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LATITUDE

-85 -80 -75 -70 -65 -60 -55 -50 -45 -40 -35 -30 -25 -20 -15 -10 -5 0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85

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256	257	258	261	265	268	271	275																										

85 80 75 70 65 60 55 50 45 40 35 30 25 20 15 10 5 0 -5 -10 -15 -20 -25 -30 -35 -40 -45 -50 -55 -60 -65 -70 -75 -80 -85

MARCH MEAN ZONAL WIND

6	13	19	23	26	26	22	18	12	5	0	-2	0	1	3	1	3	10	18	21	21	22	26	29	33	34	32	27	22	18	15	13	10	7	4	1
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-85	-80	-75	-70	-65	-60	-55	-50	-45	-40	-35	-30	-25	-20	-15	-10	-5	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	

LATITUDE

-85 -80 -75 -70 -65 -60 -55 -50 -45 -40 -35 -30 -25 -20 -15 -10 -5 0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85

APRIL MEAN ZONAL TEMPERATURE

245	246	246	247	248	250	252	254	256	258	260	261	262	262	263	264	265	265	265	264	264	264	265	266	267	268	268	267	266	265	264	263	263	1		
232	233	234	236	237	240	242	245	248	250	252	254	255	257	259	260	261	261	261	260	260	259	259	259	259	258	257	256	255	254	253	252	252	2		
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211	212	213	215	218	220	223	225	227	229	231	232	233	234	235	235	236	236	236	236	236	236	236	235	234	233	232	231	230	229	229	229	229	10		
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-85 -80 -75 -70 -65 -60 -55 -50 -45 -40 -35 -30 -25 -20 -15 -10 -5 0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85

LATITUDE

APRIL MEAN ZONAL WIND

10	21	32	41	48	52	52	50	45	39	34	31	31	34	36	34	29	23	18	15	12	11	12	14	17	19	18	16	12	9	6	4	2	1	1	
9	19	30	38	45	47	45	43	38	32	28	24	24	25	26	22	17	13	10	8	8	10	12	16	20	20	18	14	10	6	3	1	0	0	2	
8	16	25	33	37	37	35	32	27	21	16	10	6	4	2	0	-1	-2	-3	-2	0	3	7	12	17	16	13	8	4	1	0	-1	0	0	5	
6	14	22	27	30	30	27	24	20	14	9	2	-2	-5	-7	-9	-8	-7	-6	-4	-1	0	4	8	11	11	8	4	1	0	-2	-2	0	0	10	
4	9	15	19	22	21	19	16	13	8	4	-1	-4	-7	-8	-9	-8	-5	-2	-1	0	0	0	2	3	4	4	4	3	2	1	1	1	0	30	
3	7	12	16	19	19	18	16	14	10	6	2	0	-3	-4	-5	-4	-2	1	2	2	2	2	4	6	7	7	6	5	4	3	3	2	1	50	
3	6	11	14	17	19	19	18	17	14	11	7	4	2	0	-2	-2	0	3	4	5	6	8	10	11	11	10	8	6	5	5	4	3	1	70	
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0	3	7	11	16	20	23	25	25	25	24	22	18	12	7	5	5	8	12	19	24	28	29	27	22	17	13	11	9	8	7	5	3	1	150	
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0	0	2	6	11	17	21	24	23	20	17	14	11	8	4	1	0	0	0	3	8	12	15	17	19	18	15	12	10	9	8	7	5	2	0	400
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-2	-3	-4	-2	3	9	12	12	11	8	4	1	-1	-2	-3	-4	-4	-4	-4	-3	-1	0	2	3	4	4	3	2	2	1	0	0	0	0	850	
-2	-4	-5	0	7	9	9	8	5	1	-2	-4	-5	-6	-5	-5	-4	-4	-5	-5	-4	-3	-1	0	1	1	1	0	0	0	-1	-1	0	0	1000	
-85	-80	-75	-70	-65	-60	-55	-50	-45	-40	-35	-30	-25	-20	-15	-10	-5	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	

LATITUDE

-85 -80 -75 -70 -65 -60 -55 -50 -45 -40 -35 -30 -25 -20 -15 -10 -5 0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85

MAY MEAN ZONAL TEMPERATURE

243	243	243	243	242	242	242	244	248	251	255	257	259	261	262	263	263	263	264	264	264	264	265	266	268	270	272	273	274	275	276	277	277	278	279	1	
243	243	243	243	242	242	242	244	248	251	255	257	259	261	262	263	263	263	264	264	264	264	265	266	268	270	272	273	274	275	276	277	277	278	279	2	
228	229	229	229	229	230	231	234	238	242	246	250	253	255	257	258	259	260	260	260	260	260	261	263	263	264	264	264	265	265	266	266	266	266	266	3	
209	210	211	212	213	216	219	223	227	231	235	238	241	244	246	247	248	248	248	248	248	248	248	248	248	249	249	249	249	249	249	249	249	249	249	5	
209	210	211	212	213	216	219	223	227	231	235	238	241	244	246	247	248	248	248	248	248	248	248	248	248	249	249	249	249	249	249	249	249	249	249	10	
201	201	203	204	207	210	214	217	221	224	227	230	232	233	233	234	235	236	236	236	236	236	236	236	236	236	236	236	236	236	236	237	237	237	237	30	
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207	209	210	212	215	217	217	217	217	215	214	213	211	210	209	208	208	208	208	208	208	209	210	212	213	216	218	220	222	223	224	225	227	227	227	200	
209	210	211	213	215	217	218	218	218	218	218	219	219	220	220	221	221	221	221	221	222	220	219	219	218	218	219	220	221	222	224	225	226	227	226	250	
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223	224	225	227	230	232	234	237	239	242	245	248	251	254	256	257	258	258	258	257	256	255	253	251	249	246	243	241	239	237	235	234	233	232	232	500	
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251	252	254	257	261	265	268	272	275	278	282	285	287	290	291	292	293	293	293	293	294	294	293	291	288	286	283	280	277	275	272	269	266	263	262	261	1000
259	259	259	262	267	272	275	278	282	285	289	292	294	297	298	300	300	301	301	301	301	300	298	295	292	290	287	284	282	279	276	271	267	266	265		
-85	-80	-75	-70	-65	-60	-55	-50	-45	-40	-35	-30	-25	-20	-15	-10	-5	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85		

LATITUDE

MAY MEAN ZONAL WIND

10	21	32	44	55	63	67	72	74	72	69	62	57	54	50	44	34	19	5	-2	-5	-8	-10	-10	-8	-6	-4	-4	-6	-8	-9	-10	-9	-5	-2	
9	20	32	44	55	61	63	64	63	60	56	50	46	43	39	34	24	12	2	-3	-4	-5	-5	-4	-2	0	0	-2	-4	-6	-8	-7	-4	-1	2	
8	18	31	43	52	56	53	50	46	40	35	27	22	18	14	10	5	0	-6	-8	-7	-6	-5	-2	0	1	0	-1	-4	-6	-7	-6	-4	-1	5	
7	17	28	39	47	48	43	39	33	28	22	14	8	4	1	-1	-3	-6	-8	-9	-7	-6	-4	-1	1	2	0	-1	-4	-7	-8	-7	-4	-2	10	
5	12	21	29	34	34	30	26	21	15	10	5	1	-1	-3	-4	-5	-5	-5	-5	-5	-4	-3	0	0	0	0	0	-1	-3	-4	-3	-2	-1	30	
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0	1	3	7	13	18	21	23	25	26	26	25	23	19	14	8	4	2	2	4	8	12	15	18	20	20	18	14	11	9	8	7	4	1	0	300
0	0	2	5	11	15	18	21	22	22	21	19	16	13	8	3	0	0	0	0	3	7	10	13	16	16	14	11	9	7	6	6	4	1	0	400
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LATITUDE

-85 -80 -75 -70 -65 -60 -55 -50 -45 -40 -35 -30 -25 -20 -15 -10 -5 0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85

JUNE MEAN ZONAL TEMPERATURE

247	247	247	246	245	243	241	242	245	250	254	258	260	261	261	262	262	262	262	263	264	265	267	270	272	274	276	278	280	281	283	285	286	1	
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196	197	198	200	202	205	208	212	217	221	225	228	231	233	234	234	235	235	235	235	236	237	237	238	239	240	241	242	242	243	244	244	10		
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201	202	204	206	209	212	215	216	216	216	215	213	211	210	209	208	208	208	208	209	210	211	213	216	218	221	223	224	225	227	228	230	230	150	
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211	212	213	215	217	219	221	223	225	227	230	233	236	239	241	241	242	242	242	242	243	243	243	243	243	243	243	243	243	243	243	243	300		
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257	257	258	260	265	270	274	277	281	284	287	290	293	295	297	299	300	300	301	301	301	300	298	295	293	291	289	287	285	283	279	275	273	272	1000
85	80	75	70	65	60	55	50	45	40	35	30	25	20	15	10	5	0	-5	-10	-15	-20	-25	-30	-35	-40	-45	-50	-55	-60	-65	-70	-75	80	85

LATITUDE

JUNE MEAN ZONAL WIND

10	21	31	42	52	62	72	86	97	99	92	76	62	51	42	33	23	7	-7	-15	-18	-23	-27	-30	-30	-26	-24	-23	-23	-23	-21	-17	-11	-5	1	
10	20	32	44	56	65	72	80	85	83	76	63	52	43	35	27	18	4	-7	-14	-15	-18	-21	-22	-20	-17	-16	-17	-18	-19	-18	-16	-13	-8	-3	2
8	19	31	45	57	65	67	67	65	58	49	38	29	21	16	11	5	-2	-10	-14	-14	-15	-16	-16	-14	-11	-10	-11	-12	-14	-14	-12	-10	-6	-3	5
7	17	29	43	54	59	58	55	49	41	32	22	14	8	4	2	-1	-6	-10	-12	-12	-13	-14	-13	-10	-8	-9	-10	-12	-12	-11	-8	-5	-2	10	
5	13	22	33	42	45	43	38	31	23	16	9	5	2	0	-1	-2	-5	-8	-9	-9	-11	-11	-10	-7	-4	-3	-4	-5	-6	-6	-4	-3	-1	30	
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1	4	8	14	20	25	25	26	27	28	32	34	31	26	18	10	4	0	-1	-2	0	3	7	12	19	21	17	12	7	4	3	3	2	1	150	
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-1	-2	-2	0	6	11	13	13	13	12	11	8	5	2	0	-2	-3	-3	-3	-3	-2	-1	0	2	4	6	6	5	3	2	2	3	2	1	700	
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-85	-80	-75	-70	-65	-60	-55	-50	-45	-40	-35	-30	-25	-20	-15	-10	-5	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	

LATITUDE

-85 -80 -75 -70 -65 -60 -55 -50 -45 -40 -35 -30 -25 -20 -15 -10 -5 0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85

JULY MEAN ZONAL TEMPERATURE

256	256	257	257	256	253	251	250	251	254	257	259	260	260	261	261	261	261	261	261	262	263	264	267	270	272	274	276	278	281	282	284	285	1		
237	238	239	239	237	236	237	240	244	248	251	253	254	255	256	256	256	256	256	256	257	258	259	261	263	265	266	268	270	272	273	274	275	2		
211	212	213	214	215	216	218	221	225	230	235	238	241	243	244	244	245	245	245	245	246	246	247	247	248	250	251	252	254	255	256	257	258	5		
196	197	198	200	202	205	208	213	218	223	226	229	231	232	233	233	233	234	234	234	234	235	235	236	237	238	239	240	241	242	243	244	245	10		
185	186	188	191	196	201	206	210	214	217	218	218	218	218	218	218	218	218	218	218	219	219	220	221	222	223	225	226	228	229	231	232	233	30		
186	186	188	192	197	202	207	211	214	215	214	213	212	211	210	210	210	210	210	210	211	212	214	216	218	221	223	225	226	228	229	230	231	50		
189	190	192	196	200	205	209	212	213	213	212	210	207	205	204	204	204	204	204	204	205	206	208	212	215	218	221	223	225	227	228	229	230	70		
192	194	196	200	203	207	211	213	214	214	212	209	206	203	201	201	201	201	201	201	203	204	207	211	215	218	221	223	225	227	228	229	230	100		
196	197	199	201	205	209	212	215	216	217	216	214	212	210	209	208	208	208	208	208	209	209	210	212	213	215	218	221	223	224	226	227	228	230	150	
200	200	202	204	207	210	213	215	217	218	219	220	220	220	220	220	220	220	220	220	221	221	222	222	222	222	223	224	224	226	227	228	229	230	200	
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210	210	212	213	215	218	220	222	224	227	229	233	236	238	240	241	241	241	241	241	242	242	242	241	240	238	236	233	232	231	230	229	230	300		
221	222	223	225	227	229	232	234	236	239	242	246	250	253	255	256	257	257	257	257	257	257	256	255	253	250	248	246	245	243	242	241	240	400		
230	231	232	235	237	240	242	245	248	250	254	257	261	264	266	267	268	268	268	268	268	268	267	266	264	262	259	257	256	255	253	252	251	500		
243	244	245	248	252	255	258	261	264	267	270	273	277	280	281	282	283	283	284	284	284	284	284	284	283	281	279	276	274	272	271	269	267	266	265	700
250	251	252	255	259	263	267	270	273	276	279	282	285	288	290	291	291	292	292	293	294	294	294	293	291	290	287	285	282	281	280	277	274	272	271	850
258	257	257	259	264	269	274	277	280	283	286	289	292	294	296	298	299	299	300	301	301	301	299	297	295	294	291	290	289	287	283	279	277	275	1000	
-85	-80	-75	-70	-65	-60	-55	-50	-45	-40	-35	-30	-25	-20	-15	-10	-5	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	

LATITUDE

JULY MEAN ZONAL WIND

11	23	34	46	59	70	80	91	97	93	80	60	47	36	27	21	13	0	-12	-18	-21	-25	-31	-35	-36	-34	-32	-29	-28	-26	-24	-21	-17	-11	-5	
10	21	33	47	62	74	83	89	90	82	69	52	40	30	22	16	8	-3	-14	-19	-21	-24	-27	-29	-27	-24	-23	-22	-21	-20	-18	-16	-12	-8	-4	2
8	17	31	47	63	76	81	80	74	62	48	33	23	15	9	5	0	-8	-16	-19	-19	-21	-23	-23	-21	-18	-15	-14	-14	-14	-13	-11	-9	-5	-2	5
6	15	28	44	60	71	72	68	59	45	33	21	13	7	3	0	-2	-8	-13	-16	-16	-18	-19	-20	-18	-14	-12	-11	-10	-11	-9	-7	-4	-2	10	
4	11	22	35	47	54	53	47	37	27	19	11	6	3	-	0	-2	-6	-9	-11	-12	-14	-16	-16	-12	-8	-6	-5	-5	-5	-4	-2	-1	30		
3	9	17	28	38	45	44	39	31	24	18	12	8	5	2	1	0	-4	-7	-9	-10	-12	-13	-12	-8	-4	-1	-1	-1	-2	-2	-1	-1	0	50	
3	7	14	23	32	38	39	35	30	25	21	16	12	9	6	3	1	-3	-7	-8	-9	-10	-11	-9	-3	1	3	3	1	0	0	0	0	0	70	
1	4	10	18	28	34	35	33	29	27	27	25	21	15	9	4	0	-3	-7	-9	-10	-9	-7	-3	3	8	9	8	5	3	1	1	1	0	100	
0	2	7	14	22	28	29	28	29	32	34	31	25	16	8	1	-3	-7	-8	-7	-5	-2	2	10	17	17	14	9	5	4	3	2	1	150		
0	1	5	11	18	24	26	27	27	28	33	37	34	27	18	9	2	-2	-6	-7	-5	-2	0	4	12	19	20	16	11	7	5	4	3	1	200	
0	0	4	9	16	21	24	25	25	27	31	35	32	26	17	8	2	-2	-5	-5	-4	-2	0	4	11	17	18	16	11	7	6	6	4	2	250	
0	0	3	8	14	20	22	23	23	24	28	31	29	23	14	6	1	-2	-4	-4	-3	-1	0	3	10	15	16	14	10	6	6	6	5	3	300	
0	0	1	6	12	17	20	20	20	20	22	23	21	16	9	3	0	-2	-3	-4	-3	-2	0	2	7	11	13	11	8	5	4	5	5	2	400	
-1	-1	0	4	10	15	17	18	17	17	17	17	14	10	5	0	-2	-3	-4	-4	-3	-2	0	1	5	8	10	9	6	4	3	4	4	2	500	
-1	-2	-2	0	6	12	14	13	12	11	8	5	2	0	-2	0	-3	-3	-3	-3	-3	-2	-1	0	2	4	6	6	4	2	2	2	2	1	700	
-1	-3	-4	-2	3	9	11	11	10	9	7	4	0	-1	-4	-5	-5	-3	-1	0	-1	-2	-1	0	1	2	3	3	2	1	1	1	1	1	850	
-1	-3	-5	-4	0	6	9	9	8	6	4	0	-2	-5	-7	-8	-7	-3	0	1	0	-2	-3	-2	0	1	1	1	1	1	0	-1	0	1	1000	

LATITUDE

-85 -80 -75 -70 -65 -60 -55 -50 -45 -40 -35 -30 -25 -20 -15 -10 -5 0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85

AUGUST MEAN ZONAL TEMPERATURE

1	268	269	268	265	262	258	255	254	255	257	259	260	261	262	262	263	263	263	262	262	261	261	261	262	264	266	268	269	271	272	273	275	276	277
2	268	269	268	265	262	258	255	254	255	257	259	260	261	262	262	263	263	263	262	262	261	261	261	262	264	266	268	269	271	272	273	275	276	277
5	249	250	252	252	251	249	246	245	245	247	249	252	254	255	256	257	257	257	257	256	256	256	256	260	261	262	263	264	265	265	266	266	266	266
10	221	223	225	227	228	229	230	232	235	237	240	242	243	244	244	245	245	245	245	245	245	245	245	246	247	248	249	249	250	250	250	250	250	
30	202	204	206	208	211	214	217	220	224	227	229	230	231	232	233	233	233	233	233	233	234	234	234	234	235	236	236	237	238	238	239	239	239	239
100	187	188	190	193	193	204	209	214	217	219	219	219	218	218	218	218	218	218	218	218	219	219	220	222	223	224	225	226	227	228	228	229	230	230
70	186	186	188	192	193	203	209	213	216	216	216	214	213	212	211	210	210	210	210	210	211	211	212	214	216	218	220	222	223	224	226	227	227	227
100	186	186	188	192	193	203	209	213	216	216	216	214	213	212	211	210	210	210	210	210	211	211	212	214	216	218	220	222	223	224	226	227	227	227
150	188	189	191	195	195	205	210	213	215	215	213	210	208	206	205	204	204	204	204	204	205	207	209	212	215	218	220	222	223	224	226	227	228	228
200	190	192	194	198	202	207	211	214	215	215	213	210	206	203	202	201	201	201	201	201	201	203	205	207	210	214	217	220	222	223	224	225	226	227
250	194	195	196	199	203	207	212	215	217	218	217	215	212	210	209	209	208	208	208	208	209	210	212	213	215	217	220	222	223	224	224	226	227	227
300	198	199	200	202	205	209	212	216	218	219	220	220	220	220	220	220	220	220	220	221	221	222	222	222	222	222	222	222	223	224	224	225	226	227
400	203	204	205	206	209	211	214	217	220	222	224	227	228	230	231	231	231	231	231	232	232	232	232	232	231	230	228	226	225	224	224	225	226	227
500	209	209	211	212	214	217	219	222	224	227	230	233	236	239	240	241	241	241	241	241	242	242	242	242	241	240	238	236	233	231	230	229	228	228
700	220	221	222	224	226	229	231	234	236	239	242	246	250	254	256	256	257	257	257	257	257	257	257	256	255	253	250	248	246	244	242	240	239	238
850	219	230	232	234	237	239	242	245	247	250	254	257	261	265	267	267	268	268	268	268	268	268	267	266	264	262	259	257	255	253	252	250	249	248
1000	241	243	244	247	251	255	258	261	264	267	270	273	277	280	282	283	283	283	283	284	284	284	284	284	283	281	278	275	273	271	269	267	265	264
	249	250	251	254	258	263	266	270	273	276	279	282	285	288	290	291	291	292	292	293	294	294	294	293	291	290	287	284	282	280	278	275	272	270
	256	256	257	259	263	269	273	277	280	283	286	289	292	294	296	298	298	299	300	301	302	301	301	299	297	296	294	291	289	287	285	281	277	275
	-85	-80	-75	-70	-65	-60	-55	-50	-45	-40	-35	-30	-25	-20	-15	-10	-5	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80

LATITUDE

AUGUST MEAN ZONAL WIND

14	28	40	52	63	70	72	74	71	64	54	42	34	27	22	16	10	3	-2	-6	-8	-12	-16	-21	-23	-22	-20	-17	-14	-11	-9	-8	-6	-5	-2	1		
13	26	39	54	68	77	79	77	70	57	45	34	27	21	15	10	4	-2	-8	-11	-12	-15	-17	-19	-18	-16	-14	-12	-10	-8	-6	-5	-4	-3	-1	2		
9	20	35	52	70	82	83	76	63	46	31	19	12	7	3	0	-3	-9	-14	-16	-17	-18	-19	-19	-17	-13	-9	-7	-5	-4	-4	-3	-2	-1	5			
7	16	30	48	66	78	78	69	54	36	22	11	5	1	-1	-2	-4	-8	-12	-14	-15	-17	-19	-19	-15	-10	-6	-4	-3	-3	-2	-2	-1	10				
4	11	22	36	51	60	59	51	39	25	15	7	3	0	-1	-2	-3	-5	-8	-9	-10	-13	-15	-15	-11	-6	-2	0	0	0	-1	0	0	30				
3	9	18	29	41	50	50	43	34	24	17	10	7	4	1	0	-1	-4	-6	-7	-8	-10	-12	-11	-7	-2	0	2	2	1	1	0	0	50				
3	7	15	24	35	43	43	39	32	25	20	15	11	8	5	2	0	-3	-6	-7	-8	-9	-10	-8	-2	2	5	5	3	2	2	1	1	0	70			
2	5	10	19	30	38	40	36	31	27	26	24	20	14	8	3	0	-4	-7	-9	-9	-8	-6	-2	3	8	11	10	8	6	4	3	1	0	100			
1	3	7	14	23	30	32	32	30	29	33	34	31	24	15	7	0	-4	-7	-8	-6	-3	0	3	10	16	18	16	12	9	6	5	4	2	1	150		
0	1	5	11	19	25	28	28	28	29	34	37	33	26	17	8	1	-3	-6	-7	-4	-1	1	4	11	18	20	18	14	10	7	6	5	3	1	200		
0	1	4	9	17	23	25	26	26	27	32	35	32	25	16	7	1	-3	-5	-6	-3	-1	1	4	11	16	19	18	14	10	8	7	6	4	1	250		
0	0	3	8	15	21	23	24	24	25	29	31	29	22	14	6	0	-2	-4	-5	-3	-1	1	4	9	14	17	16	13	9	7	7	6	4	2	300		
0	0	1	6	13	18	20	21	20	21	22	23	21	16	9	3	0	-2	-3	-3	-2	-1	0	2	6	10	13	13	10	7	6	5	4	2	400			
-1	-1	0	4	11	16	18	18	17	17	17	14	10	5	0	-2	-3	-3	-3	-3	-2	0	1	4	8	10	10	8	6	4	4	4	3	1	500			
-1	-2	-2	0	7	12	14	14	13	12	10	8	5	2	0	-2	-3	-3	-2	-2	-2	-1	0	2	4	6	6	5	3	2	2	2	2	1	700			
-1	-2	-3	-4	-2	4	10	11	11	10	9	7	3	0	-2	-4	-5	-4	-2	0	0	-1	-2	-2	-1	0	2	3	4	3	2	1	1	1	0	850		
-2	-4	-5	-4	1	7	9	9	8	6	4	0	-3	-5	-7	-8	-6	-2	1	2	0	-2	-3	-3	-1	0	1	2	2	1	0	0	0	0	1000			
-85	-80	-75	-70	-65	-60	-55	-50	-45	-40	-35	-30	-25	-20	-15	-10	-5	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85			
LATITUDE																																					

LATITUDE

SEPTEMBER MEAN ZONAL TEMPERATURE

277	276	274	271	268	264	260	258	257	258	260	261	262	263	263	264	264	264	263	263	262	262	262	262	261	261	260	259	258	258	1		
262	262	262	261	259	256	252	250	249	250	252	254	255	256	257	258	258	258	257	257	256	255	255	254	254	253	252	251	250	249	247	2	
236	238	240	241	241	240	238	237	237	238	239	241	242	244	245	246	246	245	245	244	244	243	242	242	241	241	240	239	237	236	235	5	
215	217	219	222	224	226	227	228	229	230	230	231	232	233	233	233	233	233	233	233	233	233	232	232	232	231	230	229	228	227	227	10	
194	195	198	202	207	212	216	219	221	221	220	219	219	218	218	217	217	217	218	218	218	219	220	220	221	221	221	221	221	221	221	30	
190	191	194	198	203	209	214	217	218	218	216	215	213	211	211	210	210	210	210	210	211	212	213	215	217	218	219	220	220	221	221	221	50
191	192	195	199	204	209	213	216	216	216	214	211	208	206	204	204	204	204	203	204	206	208	211	214	216	218	220	221	221	221	222	222	70
192	193	196	200	205	210	213	216	216	216	213	210	206	203	202	201	201	201	201	201	202	204	207	210	214	217	219	221	222	222	223	223	100
194	195	197	200	204	209	214	217	218	218	217	214	212	210	209	208	208	208	208	209	210	211	212	214	216	219	221	222	223	223	224	225	150
198	199	201	203	206	210	214	217	219	220	220	220	220	220	220	220	220	220	220	221	221	221	220	220	220	221	221	222	222	222	223	224	200
204	204	205	207	210	213	216	219	221	223	224	226	228	230	231	231	231	231	231	231	231	232	232	232	231	229	227	225	224	223	222	222	250
209	210	211	213	215	218	220	223	226	228	230	233	236	239	240	241	241	241	241	241	240	238	236	233	230	228	227	225	224	224	225	300	
221	221	223	225	227	230	232	235	237	240	243	247	251	254	255	256	257	257	257	257	256	255	253	250	247	244	242	239	238	236	235	400	
230	231	232	235	238	240	243	246	248	251	254	258	262	265	267	267	268	268	268	268	267	266	264	262	259	256	253	250	249	247	245	500	
242	243	245	248	252	256	259	262	265	268	271	274	278	280	282	283	283	283	284	284	284	283	282	281	278	275	271	268	266	264	262	600	
249	250	252	255	259	264	267	270	273	276	279	283	286	289	290	291	292	292	292	293	294	294	293	291	289	287	284	280	277	275	272	700	
257	257	258	260	265	270	274	278	281	284	286	289	292	295	297	298	299	299	300	301	302	302	298	296	293	290	287	284	282	279	276	272	850
257	257	258	260	265	270	274	278	281	284	286	289	292	295	297	298	299	299	300	301	302	302	298	296	293	290	287	284	282	279	276	272	1000

LATITUDE

-85 -80 -75 -70 -65 -60 -55 -50 -45 -40 -35 -30 -25 -20 -15 -10 -5 0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85

KILOMETER MEAN ZONAL WIND

14	26	37	47	55	55	49	43	39	34	31	28	25	23	20	16	12	10	9	7	6	4	2	0	1	4	8	11	15	17	18	17	15	10	5	1
14	28	40	52	62	63	56	48	38	29	24	21	20	18	14	10	6	4	3	2	1	0	0	-1	0	4	7	10	13	15	16	15	12	8	4	2
11	24	39	55	68	72	65	53	38	23	14	8	6	4	2	0	2	-4	-6	-7	7	-8	-8	-7	-3	1	5	8	10	11	11	10	9	5	2	5
9	20	35	52	67	72	65	52	36	20	9	2	0	1	-3	-3	4	-6	-8	-9	-9	-11	-11	-9	-4	1	5	7	7	8	8	7	6	3	1	10
5	13	25	39	52	59	55	44	31	18	8	2	0	-2	-3	3	-3	-4	-5	-5	-6	-9	-10	-9	-4	0	4	5	5	5	5	4	3	1	30	
4	10	19	31	43	50	47	40	29	19	12	6	3	1	0	1	-1	-2	-3	-3	-4	-6	-7	-6	-1	3	6	7	7	6	5	5	4	3	1	50
3	8	16	26	36	43	42	37	29	21	16	11	8	6	3	1	0	-1	-3	-4	-4	-5	-5	-2	2	7	9	9	8	7	6	5	4	3	1	70
2	6	11	20	31	39	39	35	29	24	23	21	18	13	8	3	0	-2	-5	-6	-5	-3	0	3	9	13	15	14	11	9	7	6	5	3	1	100
1	3	8	15	24	31	33	32	29	28	30	31	28	23	15	7	2	-2	-5	-5	-2	0	4	9	16	21	22	19	15	10	8	7	6	4	2	150
1	2	6	11	19	26	29	29	28	28	32	35	32	25	17	9	2	-1	-4	-4	-1	1	5	10	18	23	24	21	16	11	8	7	6	4	2	200
0	2	4	9	17	23	26	26	27	30	33	30	24	16	8	2	-1	-3	-3	-1	1	5	9	16	21	22	21	16	11	9	8	7	5	2	250	
0	1	4	8	15	21	24	24	25	28	30	27	21	14	6	1	1	-3	-3	1	1	4	8	14	18	20	19	15	11	8	7	7	5	3	300	
0	0	2	6	13	18	21	21	21	22	22	20	15	8	2	0	-2	-3	-3	-2	0	2	5	10	14	16	15	12	9	6	6	5	2	400		
0	0	1	4	11	16	18	19	18	17	17	16	13	9	4	0	-2	-3	-3	-3	-2	-1	0	3	7	11	13	12	10	7	5	5	4	2	500	
-1	-2	-1	0	7	13	14	14	13	12	10	8	5	2	0	-3	-4	-4	-3	-3	-3	-2	-1	0	3	5	8	8	6	4	3	3	2	1	700	
-2	-3	-3	-2	4	10	12	12	10	9	6	3	0	-1	-4	-5	-4	-3	-1	-1	-2	-2	2	1	0	2	4	5	4	2	1	1	1	1	850	
-2	-4	-5	-4	1	7	10	9	8	6	3	0	-3	-5	-7	-7	-6	-2	0	0	-1	-3	-4	-3	-1	0	1	2	2	1	0	0	0	0	1000	
85	80	75	70	65	60	55	50	45	40	35	30	25	20	15	10	5	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	

LATITUDE

281	278	275	272	269	267	265	264	264	265	265	266	265	265	265	265	265	265	264	264	265	265	264	264	263	263	262	261	259	257	255	253	251	249	247	246	244	243
282	279	276	273	270	268	266	265	264	263	262	261	260	259	258	257	256	255	254	253	252	251	250	249	248	247	246	245	244	243	242	241	240	239	238	236	234	231
283	280	277	274	271	269	267	265	264	263	262	261	260	259	258	257	256	255	254	253	252	251	250	249	248	247	246	245	244	243	242	241	240	239	238	236	234	231
284	281	278	275	272	269	267	265	264	263	262	261	260	259	258	257	256	255	254	253	252	251	250	249	248	247	246	245	244	243	242	241	240	239	238	236	234	231
285	282	279	276	273	270	268	266	265	264	263	262	261	260	259	258	257	256	255	254	253	252	251	250	249	248	247	246	245	244	243	242	241	240	239	238	236	234
286	283	280	277	274	271	269	267	265	264	263	262	261	260	259	258	257	256	255	254	253	252	251	250	249	248	247	246	245	244	243	242	241	240	239	238	236	234
287	284	281	278	275	272	269	267	265	264	263	262	261	260	259	258	257	256	255	254	253	252	251	250	249	248	247	246	245	244	243	242	241	240	239	238	236	234
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294	291	288	285	282	279	276	273	270	268	266																											

85 80 75 70 65 60 55 50 45 40 35 30 25 20 15 10 5

OCTOBER MEAN ZONAL WIND

6	11	14	18	20	17	12	10	10	10	12	13	13	13	12	8	10	17	26	28	25	24	25	27	31	34	37	39	40	41	39	36	30	21	10	1		
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-85	-80	-75	-70	-65	-60	-55	-50	-45	-40	-35	-30	-25	-20	-15	-10	-5	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85			
LATITUDE																																					

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282	280	279	277	275	274	273	273	273	272	271	269	267	266	265	265	264	264	263	263	262	261	260	258	255	252	249	247	246	245	244	243	243	242	1	
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LATITUDE

-85 -80 -75 -70 -65 -60 -55 -50 -45 -40 -35 -30 -25 -20 -15 -10 -5 0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85

NOVEMBER MEAN ZONAL WIND

-2	-5	-10	-12	-14	15	-15	-14	-13	-12	-10	-9	-9	9	-10	-12	6	11	29	35	34	36	42	48	55	57	57	54	50	46	42	36	29	21	11
0	-1	-5	-7	-8	-11	-12	12	-11	-9	6	-3	3	-4	5	-8	4	9	23	28	27	29	34	39	44	47	47	46	45	43	39	34	28	19	10
1	2	2	1	0	-2	-4	6	-7	-7	6	3	3	-4	5	7	5	1	9	11	11	13	17	21	27	30	32	34	35	35	33	29	24	17	8
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3	7	13	17	19	17	13	8	4	0	-2	-5	-6	-7	-8	-8	-6	-3	0	0	0	2	4	8	11	13	16	18	19	20	19	16	11	5	
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-1	-2	-2	0	5	11	15	15	14	11	8	5	2	0	-1	-2	-3	-4	-5	-4	-2	0	2	5	8	10	10	9	7	5	3	2	1	0	
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85	-80	-75	-70	-65	-60	-55	-50	-45	-40	-35	-30	-25	-20	-15	-10	-5	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85

-85 -80 -75 -70 -65 -60 -55 -50 -45 -40 -35 -30 -25 -20 -15 -10 -5 0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85

LATITUDE

DECEMBER MEAN ZONAL TEMPERATURE

290	289	287	285	283	281	279	278	276	274	272	269	267	265	264	263	263	263	263	263	262	262	261	259	256	252	249	247	247	247	248	248	248	1				
279	279	277	276	274	273	271	270	268	266	264	262	261	259	258	258	257	257	257	256	256	255	254	253	250	247	243	240	237	236	235	235	234	234	2			
263	262	262	260	259	258	256	254	252	251	249	248	247	246	245	245	244	244	244	243	242	241	240	237	234	231	227	225	223	221	220	219	218	217	5			
250	250	249	248	246	245	243	241	239	237	236	235	234	234	233	233	232	232	232	232	231	231	230	229	228	225	223	220	218	216	213	211	210	208	10			
239	239	238	236	234	232	229	227	224	222	220	218	217	216	216	215	215	215	215	216	216	216	216	216	216	216	216	216	214	212	209	206	204	202	200	30		
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225	225	225	225	223	221	218	215	213	211	210	209	208	207	207	207	207	207	207	208	208	210	212	214	216	217	217	217	217	216	215	214	212	211	210	150		
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262	263	264	265	266	268	271	274	277	281	285	288	290	291	292	292	292	292	292	292	291	289	286	283	279	274	270	266	263	260	257	255	253	251	251	850		
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-85	-80	-75	-70	-65	-60	-55	-50	-45	-40	-35	-30	-25	-20	-15	-10	-5	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85			
LATITUDE																																					

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DECEMBER MEAN ZONAL WIND

-4	-10	-17	-22	-25	-28	-30	-31	-33	-36	-38	-39	-40	-40	-40	-37	-26	-6	11	19	20	24	31	40	52	59	60	57	52	47	41	35	29	20	10	1
-2	-6	-12	-16	-19	-22	-25	-26	-26	-27	-27	-28	-29	-30	-31	-30	-21	-5	10	16	17	20	26	33	41	47	50	50	48	46	41	36	29	20	10	2
-2	-4	-8	-12	-14	-16	-17	-18	-18	-18	-18	-19	-19	-20	-21	-15	-5	3	8	8	10	14	19	25	30	34	38	40	41	39	34	27	18	9	5	
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-85	-80	-75	-70	-65	-60	-55	-50	-45	-40	-35	-30	-25	-20	-15	-10	-5	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	

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